A MODEL OF CONCEPTUAL STRUCTURE MAPPING

By

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The present dissertation proposes a model of bilingual memory. The notion of conceptual structure is introduced to denote a manner in which conceptual knowledge is lexically represented in a language. The major claim here is that bilingual lexical and conceptual processing is accomplished via conceptual structure mapping. The model assumes that production patterns of a bilingual speaker are largely affected by the degree of (in)compatibility between conceptual structures of two languages. A series of experiments were designed and conducted in order to obtain supporting empirical evidence. A discussion of the results along with a review of prior experimental work show evidence for the position advanced here. In addition, it is argued that the model proposed here can correct inadequacies observed in other models of bilingual memory and that it can be extended to account for other issues of language production and development.

CHAPTER 1
INTRODUCTION

Bilingualism has emerged as a discrete field. It developed out of studies in cognitive psychology and linguistics investigating the relationship between language and cognition. The growing body of knowledge on bilingualism has influenced the evolution of models designed to capture the intricate symbiosis of lexical and conceptual representations in the memories of bilingual[1] speakers. Despite the increasing descriptive accuracy achieved by some models, a number of problems remain unresolved. Transfer, code-switching, and developmental issues are among them. The resolution to the problem may lie in a different approach to representation. This work proposes a model of conceptual structure mapping which will be reviewed as a dynamic approach to representational issues. The model provides an account for all existing empirical evidence and will accommodate the remaining problems, as well.

[1] In the literature the term 'bilingual' is applied in a very broad sense. It has been used to refer to balanced/fluent bilingual speakers as well as to novice second language learners. The term is also used to refer to individuals who speak more than one language.

CHAPTER 2
BILINGUAL MEMORY RESEARCH

Bilingual research literature offers a number of different approaches to the issues of bilingual production and development. The largest group of studies on bilingualism focuses on the issues of storage and representation. The central argument of the models addressing storage issues is whether conceptual information is represented in language-specific or amodal way. In particular, the studies have been trying to establish whether a bilingual's two lexicons are represented in separate memory stores (the separate code view) or whether they are represented in a single memory system (the common code view). The extensive experimental research produced the data which was often interpreted as supporting one view or the other (McCormack, 1977; Kirsner, Smith, Lockhart, King, & Jain, 1984; Scarborough, Gerard, & Cortese 1984; Tzelgov & Eben-Ezra 1992; Williams 1994). Durgonoglu and Roediger (1987) pointed out that the studies often neglected the conditions under which language-dependent and language-independent processes may influence the results. A series of experiments was conducted to demonstrate that different types of tasks produce results that lead to different conclusions. Specifically, data-driven tasks like word fragment completion and repetition priming produce results that draw attention to the surface characteristics of the stimuli and support the separate code view. Conversely, conceptually-driven tasks like free recall

and translation draw attention to the conceptual content of the stimulus and generally produce results that support the common code view.

Heredia, Weldon and McLaughlin (1991) provided additional evidence that data-driven tasks generate results supporting the separate code view whereas results obtained in conceptually- driven tasks provide support for the common code view of bilingual memory. Their first experiment replicated the findings of Durgonoglu and Roediger (1987). In the second experiment the generality of the previous findings was extended even further. It was suggested that conceptual information might aid performance on a data-driven task if it could be used to retrieve perceptual properties of the stimuli studied. Therefore, the participants were given explicit instructions to use English fragments as cues to generate Spanish translations after viewing monolingual and bilingual word lists. Conceptual information, and as predicted the test instructions required the use of both perceptual and conceptual information, the performance was reported to be comparable in both within- and between-language conditions. The findings reported by Smith (1991) provided additional evidence that it is possible to obtain cross-language facilitation in traditional data-driven tasks. The absence of cross-language facilitation on word-fragment completion tasks reported by Durgonoglu and Roediger (1987) and Watkins and Peynircioglu (1983) was due to absence of semantic involvement at study, where Spanish and English stimuli (in the former study) and Turkish and English stimuli (in the latter study) were presented as random word lists. Smith (1991) used English and French sentences that created associations with the stimuli presented as fragments during a word-fragment completion task. The sentences did not use overt word forms, thus eliminating the possibility of reliance on perceptual properties of the material studied. The results

demonstrated that sentence processing at study leads to semantic involvement at test and hence to cross- language facilitation in a word-fragment completion task. As concluded in Tobossi (1988), Smith (1991) and Hummel (1993), experiments using single-word stimuli are more likely to demonstrate results supporting the independent view of bilingual memory representation, because the study and test demand attention to surface characteristics. On the contrary, use of contextually-embedded stimuli is more likely to support the interdependent view, because contextual activation involves more abstract levels of representation. Along these lines, it is important to note that availability of contextual information should be regarded an important factor by the studies addressing issues of lexical and conceptual access. Contextual embedding of lexical stimuli helps to discriminate between different senses that may be activated upon presentation of a lexical form, and to channel activation in a particular direction. The use of contextual information is of particular importance for bilingual studies, since it provides a means to distinguish between inter- and intralanguage organizational patterns.

The two competing views have been replaced by models that consider hierarchical organization of conceptual and lexical representations in bilinguals. The dual-coding theory (Paivio & Desrochers, 1980) was put forth to account for the discrepancies between data-driven and conceptually-driven tasks in terms of variability of encoding (Arnedt & Gentile, 1986; Paivio, Clark, & Lambert, 1988; Vaid, 1988). Two systems (verbal/symbol and conceptual/imagery) were proposed to be connected, yet independent. On the basis of the findings that pictures were categorized faster than both L1 and L2 words, it was concluded that one system could be sometimes activated without the other. That is, in picture categorization tasks conceptual representations could be accessed via

visual stimuli. Although the verbal system could be also activated, its activation was not a necessary condition for conceptual access. The theory however has been criticized on the grounds that it reduces conceptual representations to visual and verbal codes (Potter & Kroll, 1987).

The hierarchical models proposed by Paradis (1981), Potter, So, Von Eckardt, and Feldman (1984), and Snodgrass (1984, 1993) posit separate stores in which the conscious representations of verbal and pictorial stimuli occur. Current research in the area of bilingual memory has been centered around the two plausible models proposed by Potter, So, van Eckardt, & Feldman (1984). The models differ in the connections they assume between the conceptual and the lexical levels (see Figure 2-1). The word

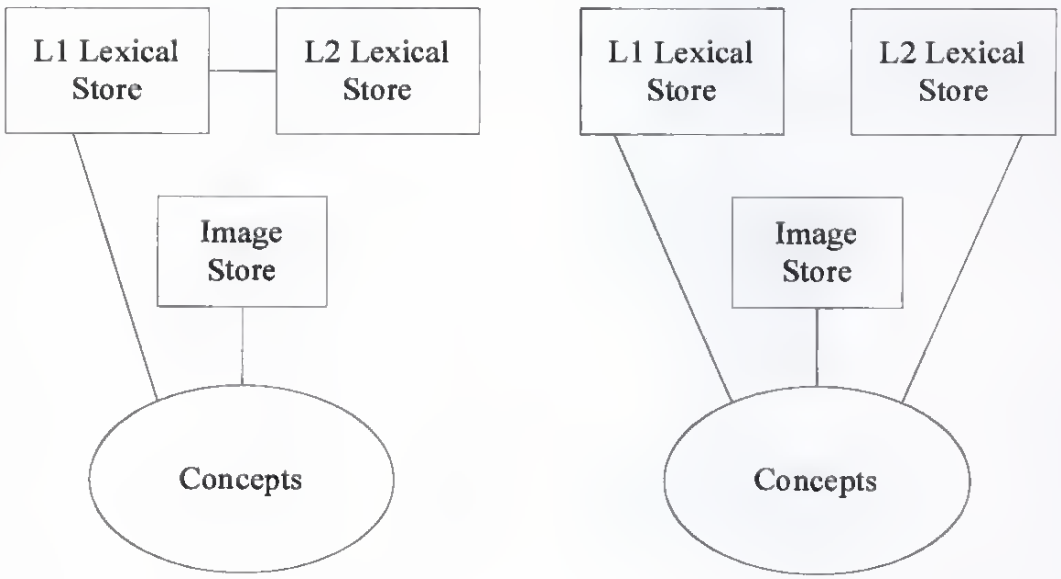

Figure 2-1. Word association and concept mediation models as proposed by Potter, So, van Eckardt, & Feldman (1984).

association model postulates that the word meanings in the second language (L2) are accessed via the bilingual's dominant language (L1), which is directly connected to the conceptual store. The concept-mediation model assumes a direct connection between the L2 lexical store and the conceptual store. The comparison of translation to picture naming in L2 was viewed as a critical test for the models proposed. According to the word association model, translation should take less time than picture naming in L2. That is, in translation tasks, bilinguals need only associate the words stored in two different lexical systems, whereas in picture naming tasks bilinguals first access conceptual storage, mediate the concept with a lexical representation in L1 and only then associate the L1 lexical item with a translation equivalent in L2. According to the concept mediation model, both tasks require access to a conceptual level; therefore translation from L1 to L2 should take approximately the same amount of time as picture naming. [1]

The experimental studies demonstrated a dissociation in performance of less and more fluent bilinguals (Potter, So, von Eckhardt, & Feldman 1984, Kroll & Curley 1988, Chen & Leung 1989). There was an asymmetry in translation latencies with longer times taken to translate from L1 to L2, and significantly shorter translation times in the opposite direction. As in picture naming studies, the differences between L2 and L1 output were reported to be smaller for more fluent bilinguals than for less fluent bilinguals. Hence, models were proposed to capture successive developmental stages in bilingual lexical organization. The word association model was proposed to describe processing patterns of novice bilinguals, who presumably mediate between the conceptual store and the L2

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[1] The latter prediction may be true if pictures cannot directly elicit their names.

lexical store via L1 lexical representations. Conversely, the concept mediation model supposedly reflects the ability of expert bilinguals to access concepts from either lexical store directly. Some findings, however, were not consistent with the proposed dichotomy. Significant asymmetries were reported even for very fluent bilinguals (Keatly, Spinks, & Gelder 1990), whereas according to the models, fluent bilinguals should exhibit less asymmetry in their production. De Groot and Nas (1991) reported equality of associative-priming effects within and between languages, even though the overall response time latencies obtained for L2 primes were larger than the latencies obtained for L1 primes.

To accommodate the contradictory evidence, it was suggested that the relationship between the word association and concept mediation stages in a bilingual speaker's development is overlapping rather than strictly dichotomous (Kroll, 1993). The two models have been amalgamated in the mixed model (Potter, Kroll, Yachzel, Carpenter, & Sherman, 1986) that posits one common conceptual and a number of separate lexical stores. The lexical stores are related indirectly via the common conceptual store and directly at the lexical level of representation. It has been demonstrated that such a configuration successfully accounts for the results which reveal both word association and concept mediation processing patterns at the same level of bilingual proficiency.

The mixed model was later developed into the revised hierarchical model (Kroll 1993, Kroll & Stewart 1994, Dufour & Kroll 1995), which was proposed to deal with a wider range of bilingual data. Specifically, it was designed to accommodate the asymmetric patterns associated with bi-directional mediation between a bilingual's lexical stores. The asymmetric patterns of the results have been associated with a representational configuration which assumes that languages are connected via the

conceptual level when the direction of mediation proceeds from L1 to L2, and that only the lexical level is employed in the opposite direction (see Figure 2-2).

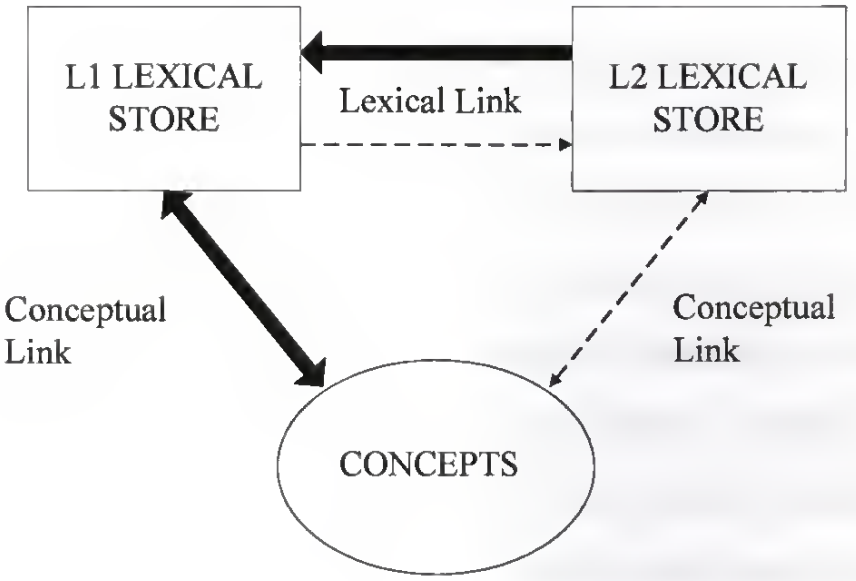

Figure 2-2. The revised hierarchical model as outlined in Kroll (1993), Kroll and Stewart (1994), and Dufour and Kroll (1995). The thick solid lines stand for very strong connections, and the dashed lines stand for weaker connections.

Kroll and Stewart (1994) employed transfer-appropriate processing logic to test the representation proposed in the revised hierarchical model. According to the principle of transfer-appropriate processing, memory performance is a function of the overlap between study and test operations. In other words, performance on the test depends on the overlap between the types of processing required by the encoding condition and the test (Morris, Bransford, & Franks, 1977; Roediger & Blaxton, 1987). Since mediations from L1 to L2 and from L2 to L1 were hypothesized to engage different activation patterns,

translations from L1 to L2 and from L2 to L1 were used to test the hypothesis. Categorized and randomized word lists in L1 and L2 were used as stimuli. Categorized lists were expected to draw attention to conceptual properties of the stimulus material, and consequently, create interference in the tasks that require conceptual activation (picture naming and translation from L1 to L2). On the other hand lexical-level processing was predicted to have no effect on the tasks that do not require access to the conceptual level of representation (word naming and translation from L2 to L1). L1-to-L2 and L2-to-L1 translations of randomized and categorized lists were compared to word and picture naming in L1 and L2. The findings supported the prediction that the two directions of translation engage different interlanguage connections. Category interference in bilingual translation was reported only when translation was performed in the direction from L1 to L2. The results obtained from the incidental recall task also agreed with the principle of transfer-appropriate processing. That is, the direction of translation that was hypothesized to require concept mediation (L1>L2) had a category interference effect in production but a category advantage in recall. The direction of translation that was hypothesized to be lexically mediated (L2 >L1) was insensitive to the effects of semantic context in production and also in recall.

The directional asymmetry was also demonstrated in semantic priming experiments. Priming effects reported were significantly greater when primes were presented in L1 and targets were presented in L2 than when primes were presented in L2 and targets were presented in L1 (Neely, Keefe, & Ross 1989, Altarriba 1992, Kroll & Sholl 1992). It was suggested that similar to L1-to-L2 translation L1 priming of L2

targets initiates the interlanguage connection in the direction from L1 to L2 and therefore should result in greater semantic activation than L2 priming of L1 targets.

Additional evidence for the representational organization proposed in the revised hierarchical model was provided by Sholl, Sankaranarayanan, and Kroll (1995). The study they conducted examined the effects of prior picture naming on translation latencies. According to the transfer-appropriate processing principle and the representational organization proposed in the model, prior picture naming should affect translation latencies only in the L1-to-L2 direction, because only this direction was proposed to require concept mediation and, therefore, only this direction could share the same underlying semantic processes as picture naming. The results confirmed the prediction. The significant facilitation in translation from L1 to L2 following picture naming in both L1 and L2 and the absence of transfer in the opposite direction were interpreted as evidence for the dissociation between the types of processes engaged, given the direction of mediation between L1 and L2 bilinguals' lexical stores.

Since the retrieval of picture names did not affect translation times in the L2-to-L1 direction, it was also proposed that the locus of transfer was not at the level of retrieving the lexical form. The latter inference, however, is not fully supported by the experimental data. The magnitude of facilitation in L1-to-L2 translation was significantly greater for the stimuli previously named in L2 than for the stimuli named in L1. The observed difference cannot be explained in terms of greater conceptual activation during L2 picture naming, because picture stimuli should produce equal conceptual facilitation, regardless of the target language in the naming task. According to the principle of transfer-appropriate processing and the representational organization of the revised

hierarchical model, both L1 and L2 picture naming should produce equal facilitation in the task that requires activation at the conceptual level of processing, i.e. in translation from L1 to L2. The data, however, suggests that some lexical activation is possible in the direction from L1 to L2. To equalize contradictory evidence, one could suggest that shorter translation times following L2 picture naming could result from long-lag repetition effects. In other words, accelerated production of L2 lexical forms in L1-to-L2 translation tasks could be influenced by prior articulation of these forms in the L2 naming task. This proposal does not contradict the mixture assumption of processing (Cabeza, 1995). The mixture assumption says that conceptual and perceptual processing should be viewed in terms of two distinct continua that do not necessarily trade off against each other (Roediger & McDermott, 1993). Wheeldon and Monsel (1992), suggested that long-lasting facilitation could be a results of repeated exercise of the mapping from meaning to phonological form. As demonstrated in the experiments conducted by Monsell, Matthews, and Miller (1992), prior production of word forms in the naming task and in response to a definition effected long-lasting repetition priming in the picture naming task. This account of differential facilitation in L1-to-L2 translation following L1 and L2 picture naming is compatible with the main assumptions of both the revised hierarchical model and the transfer-appropriate processing principle, but it does not explain why such an effect was not present in the L2-to-L1 direction. The discrepancies found between the data and some essential theoretical assumptions cannot be resolved within the representational organization of the revised hierarchical model.

Developmental Changes in Bilingual Representation

The studies that compare the performance of less and more fluent bilinguals in picture naming, word translation, and lexical decision tasks reported a dissociation in the response patterns of the less and more fluent bilingual speakers (Chen & Leung, 1989; Kroll & Curley 1988; Altarriba, 1992). Less fluent speakers exhibited significant asymmetries in response time latencies. Conversely, response time asymmetries obtained from more fluent bilinguals were not significant. Similarly, more fluent bilinguals demonstrated comparable priming effects in both directions (De Groot & Nas, 1991). Dufour and Kroll (1995) proposed that there is a developmental shift in the way bilinguals mediate between their two languages. As bilinguals become more proficient, they develop more conceptual nodes that can be activated by both L1 and L2 lexical items, in which case they gradually switch to conceptual mediation in both directions (see Figure 1-2). The developmental proposal was expected to demonstrate a degree of empirical adequacy, since it was developed from translation latency data obtained from less and more fluent bilinguals in several previous studies (Potter et al. 1984, Kroll and Curley 1988, Chen and Leung 1989). However, the results reported by Kroll and Curley (1988) show that a switch to conceptual mediation may occur quite early, long before novice bilinguals achieve production fluency.

Additional evidence for early conceptual involvement in novice bilinguals was provided by Griffin and Harley (1996). They examined effects of the direction of association on word list learning. Four groups of novice English-French bilinguals were given a list of words which two groups studied in the L1-to-L2 direction and another two

groups studied in the L2-to-L1 direction. The groups performance was later tested in translation tasks from L1 to L2 (a production task) and from L2 to L1 (a comprehension task). Conditions at encoding and test were partially counterbalanced. It was found that matching encoding and retrieval conditions and using L1 as a target language (comprehension) were particularly favorable for a better performance at test, whereas direction of learning (i.e. direction of association) had no significant effect on group performance. A comparison between the two directions of learning over the comprehension and production tasks showed that word association learning from L1 to L2 was less disadvantaged by the demands made on it under the reverse condition (i.e. translation from L2 to L1) than was the L2-to-L1 learning condition. In other words, it was demonstrated that in word-association learning, a more stable performance at test resulted when learning proceeded in the direction associated with conceptual processing.

According to the revised hierarchical model word association in the direction from L2 to L1 is achieved at the lexical level of processing and should provide a stronger interlanguage connection for novice bilinguals than the direction from L1 to L2 which is considered to be established at the conceptual level of processing. Furthermore, it was suggested that L2-to-L1 lexical connections are stronger than those from L1 to L2, because "second language words are frequently taught by associating them to first language (e.g., *casa* means 'house') but not vice versa" (Kroll 1993, p. 70). The findings of Griffin and Harley (1996) were not compatible with the above assumptions. It was demonstrated that direction of association was not a crucial factor affecting bilingual performance at test as compared to matching of encoding and retrieval conditions. Additionally, it was shown that successful retrieval of a lexical form largely depends on

how well a given lexical representation is established in the memory of a bilingual speaker. The latter evidence suggests that the issue of directionality is relevant as long as there is a significant developmental asymmetry in L1 and L2 representations. It also suggests that the dichotomy between lexical and conceptual processing in the bilingual memory may not be as strict as defined in the reviewed models of bilingual lexical and conceptual representation.

Concept Acquisition and Representation

The bilingual research paradigm has concentrated on representational issues without regard to the issues of lexical and conceptual development. A developmental approach may provide insights to the problem of the bilingual representation, because it considers representation as the relations between conceptual and lexical information within a functional context. The findings from word and category learning studies suggest that concept acquisition cannot be considered without social-pragmatic and functional contexts (Tomasello 1996). Social-pragmatic contexts are closely associated with activities and routines such as schemas and scripts, which provide a framework for emerging functional and thematic categories. As reported in object-sorting studies (Fivush, 1987), 14- and 20-month-old infants tend to select objects sequentially in the same script category (kitchenware vs bathroom accessories) from the total set of objects available to them at a greater than chance level probability. Although the script-based categories are assumed to be functional, many of the categories develop into traditional taxonomic categories (e.g. furniture, clothing). Findings from semantic priming studies showed that categorical organization constitutes an important factor in lexical and

conceptual access (Collins & Quillian 1969, Meyer & Schvanveldt 1971, Collins & Loftus 1975).

Language-Specific Organization and Bilingual Representation

Variations in socio-cultural routines affect the relative structure of the knowledge-based constructs that determine lexical-conceptual activation patterns. Mappings of lexical-conceptual relations onto knowledge-based constructs are lexicalized in the ways that may not be shared across languages. The following often-cited example from Talmy (1985) demonstrates different lexicalization patterns of conceptual primitives such as MOTION, PATH, FIGURE, GROUND and MANNER in English (1) and Spanish (2):

(1) The bottle floated into the cave.

(2) La botella entro flotando en a la cueva.

English was said to conflate MOTION and MANNER into a single lemma "float", whereas in Spanish speakers use separate lemmas to convey these conceptual primitives. However, in Spanish the lemma "entro", which denotes MOTION, also makes reference to PATH and GROUND. The implication is that for Spanish-English bilinguals Spanish lexicalization patterns are associated with a lower activation threshold than contrasting English lexicalization patterns, unless the contrasts are highlighted by relevant contextual information. Since social- pragmatic contexts specify encoding and retrieval conditions, they may be used as a point of reference for matching lexical and conceptual representations in lexical access. Hence the relation between lexical-conceptual mappings and knowledge-based constructs provides a valuable theoretical component that has not been considered by the models of bilingual lexical representation and storage.

CHAPTER 3
THE MODEL OF CONCEPTUAL STRUCTURE MAPPING

The purpose of the present study is to propose a model of bilingual memory that considers traditional issues of lexical and conceptual development like concept formation and word learning as central to the issues of storage and representation. The model claims that the representational organization of bilingual memory arises from relations between conceptual and lexical information in given socio-pragmatic and functional contexts.

The proposed model introduces the notion of conceptual structure as its major functional component. Conceptual structure can be succinctly defined as a set of knowledge-based constructs such as frames, domains, and schemas that accommodate the conceptual knowledge and lexical items of a language in a way which reflects language-specific lexicalization patterns. The configuration of a given conceptual structure is determined by a number of contributing factors, e.g. the perceptual abilities of a language learner, the socio-pragmatic context of concept-acquisition episodes, and the available linguistic means. Stable cooccurrence of these factors determines a central tendency in the formation of a conceptual structure. This central tendency ensures that the speakers of a given language community possess highly compatible conceptual structures. Instability within the structure is associated with variability of the aforementioned contributing factors and with different degrees of entrenchment of particular structural elements within the memory of an individual speaker. The degree of entrenchment of a particular part of

the structure may be specified in two ways. It may be specified in terms of the overall frequency of activation which accumulates during the lifetime of the structure or in terms of contextual saliency of recent activation episodes.

Conceptual structure constitutes a heuristic device that explicates observed activation patterns in terms of a relational network organization of conceptual and lexical material. The notion of conceptual structure and its functions are explained in the structural and developmental assumptions elaborated below.

The Structural Assumption

The key components of the structural assumption draw heavily upon the theories and empirical findings of cognitive semantics and cognitive psychology. The present description of the model is not fully formalized. The formal mechanisms assumed include a relational network storage system with spreading activation. These are compatible with several theories, e.g. Lamb's stratificantional theory[1] and Langacker's Cognitive Grammar[2], but the model I use herein is not fully specified.

One component of the structural assumption encompasses the same structural principles as the ones developed in Langacker's relational-network (RN) model.[3] The RN model was proposed to capture the relationships that hold between various senses of

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[1] Lamb 1966, 1971.

[2] A more comprehensive review of Cognitive Grammar can be found in Langacker 1987 and Rudzka-Ostyn 1988.

[3] Langacker's model is neither the first nor the most highly elaborated one available, but it suffices as a starting point for the preliminary studies herein.

lexical items and to provide a theoretical construct for the prototype model of categorization. [4]

The RN model maintains that the senses of lexical items (= relational connections) in a network are determined by two types of relationships: schematicity and extension. Schematicity represents the degree to which a particular sense can be defined: a finer-grained instantiation or specialization, and a more approximate representation or abstraction. An extension is a relationship in which some basic specifications are suspended or ignored to form a new meaning.

In the example provided by Langacker (1988), a relational network of the lexical item *ring* was modeled to demonstrate relationships of schematicity and extension. Thus, the meaning 'a circular piece of jewelry' can be said to represent a specialization of a more abstract sense 'a circular object'. The relationship between the meaning 'arena' and the abstraction 'a circular object' represents an extension, in which strict geometric specifications are suspended and only functional specifications remain relevant (see Figure 3-1).

Langacker's relational networks were introduced primarily to address issues of category membership and to account for prototype effects. Although no specific configuration was required by the facts, the RN approach addressed only functional-similarity relation between senses in a network. A more varied approach to access and activation issues that permits any analogical connection between nodes in relational

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[4] Prototype Theory and the notion of prototype in its current interpretation have been developed in a series of experiments and papers by Rosch (1973, 1974, 1975a, 1975b, 1978).

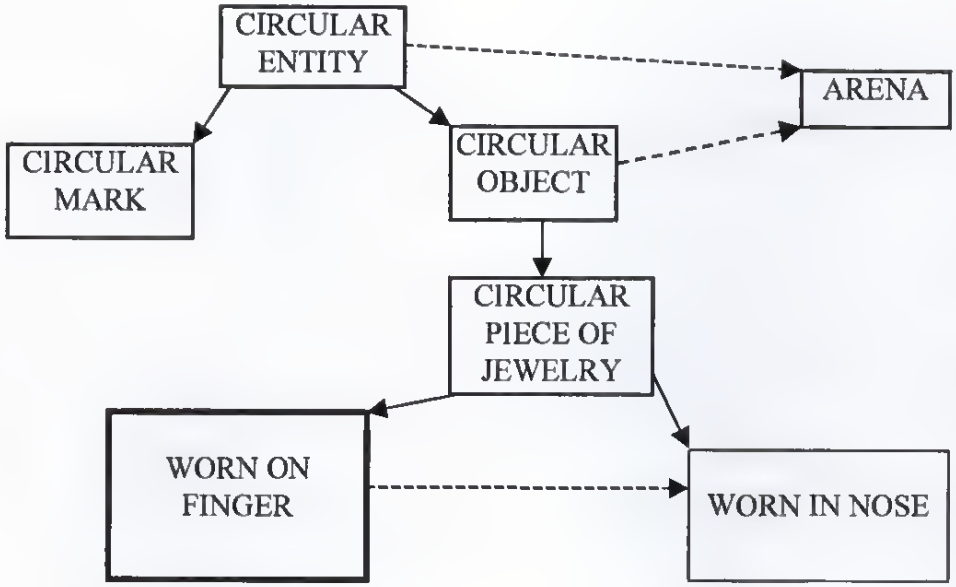

Figure 3-1. A relational network of the English lexical item *ring* proposed hy Langacker (1988). Prototypical meaning is given in hold. Dashed lines point to sense that are extensions of the corresponding ahstractions and specializations.

networks was not considered. Consequently, the networks were given a rigid structural organization, which can not account for the instability in activation patterns observed in different contexts. Various phenomena associated with instability in graded categories have been largely explored in the works of Barsalou (1983,1985, 1987). Barsalou maintains that all categories, formal, linguistic and goal derived, possess a graded structure. Graded structure reflects a degree of activation during access. Graded structure can vary substantially with changes in linguistic context and in point of view; that is, particular concepts may become more or less accessible in various contexts.

Unlike the relational network model, the frame-based organization proposed by Barsalou (1992) employs an extensive knowledge base to account for effects arising from

the instability of graded structures. Barsalou argues that it is implausible to maintain that the wide range of graded structures observed are all stored in long-term memory. He also proposed that people can construct a wide range of concepts and relations for the same category in working memory. Figure 3-2 provides an example of the frame for the concept 'vacation'. The frame provides a wide knowledge base that contributes to concept formation. Depending on the context, personal goals, or point of view, people incorporate different information from long-term memory into the current concept that they construct for this category.

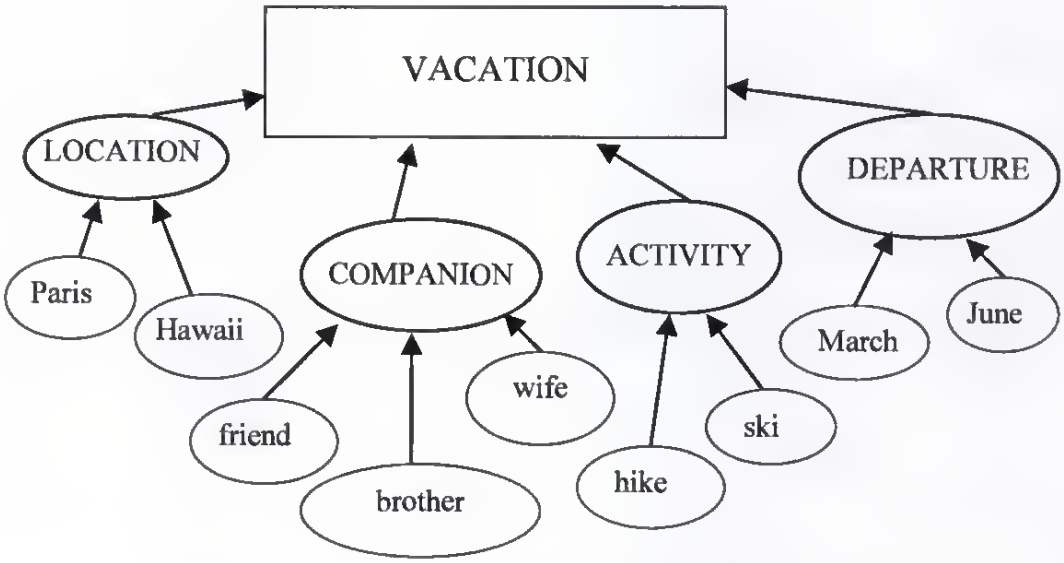

Figure 2-2. Example of a frame for 'vacation' proposed by Barsalou (1992).

Barsalou's approach to categorization has been criticized for its rather unconstrained nature (McCauley 1987). Indeed, it is unlikely that such highly structured

body of knowledge as language would be without any stable organization and would depend largely on temporary constructs composed in working memory.

The present study employs both an RN and a frame-based approach to produce a theoretical construct that could constitute a stable, yet dynamic representational organization. Such a representation is needed to account for lexical-conceptual activation patterns that are both persistent and unstable. A conceptual structure notion is proposed to accommodate this need. Organizationally, a conceptual structure is best rendered as a network of relational networks. Figure 3-3 captures a part of the conceptual structure of the English language which may be activated upon a presentation of the lexical form *ring*. The multi-tiered network depicted incorporates both approaches: a network of interrelated senses and a frame-based organization. Tiers constitute frames of reference in which only one particular sense in the relational network can be fully specified. The connections between senses of lexical item resemble relations proposed in the RN model, whereas relations between senses within a given tier/frame of reference are similar to the ones proposed within a frame-based approach.

The organization of tiers given in Figure 3-3 is arbitrary and is dictated partly by limitations of the two dimensional format. The organization of tiers reflects activation patterns which are largely influenced by such factors as socio-pragmatic context, frequency of activation, and degree of entrenchment. These factors are also likely to affect conceptual structure formation for each speaker. The common abstraction 'circular entity' is schematically represented between tiers so as to provide a connection between various frames of reference. The common abstract representation constitutes a conceptualization of a relation between an entity/concept and the environment of its

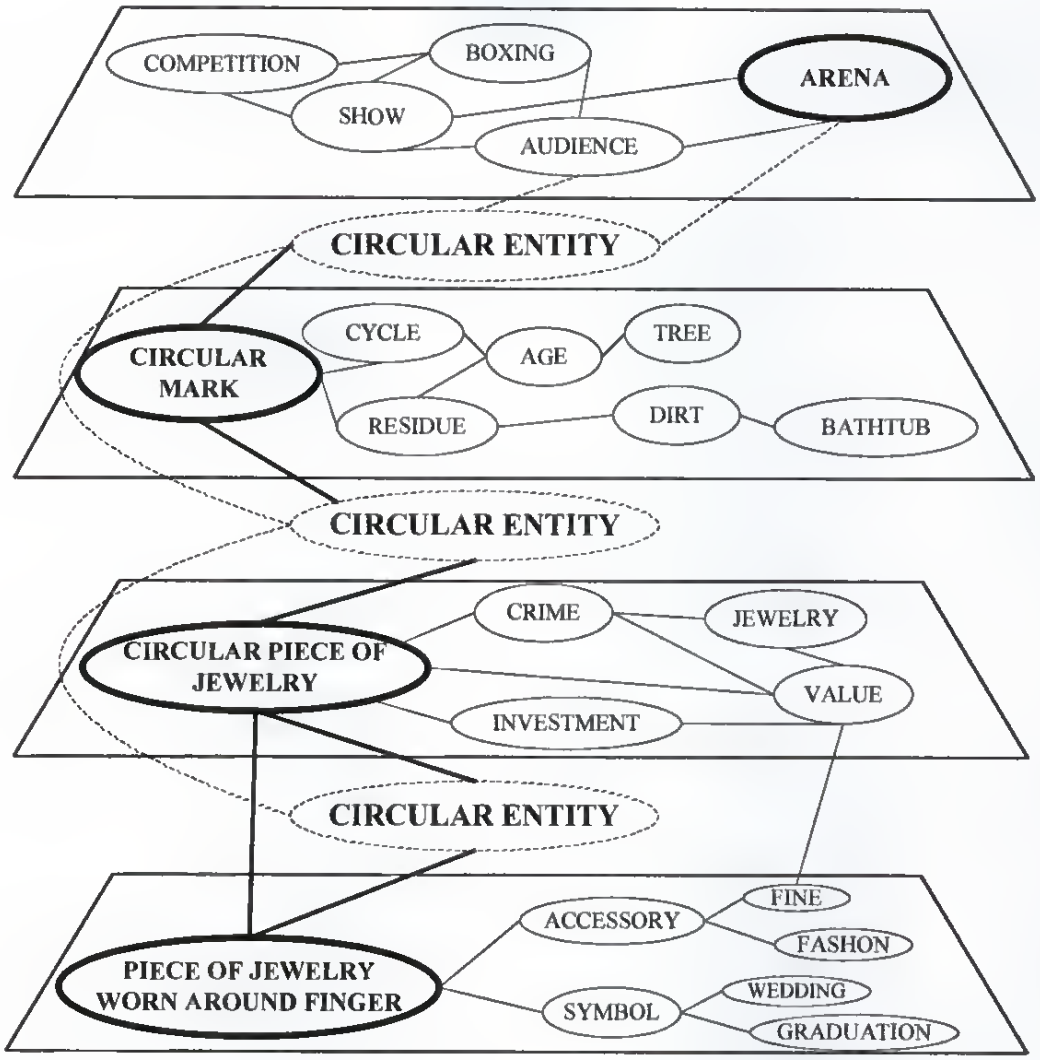

Figure 3-3. A schematic representation of a part of the English conceptual structure associated with the lexical form *ring*.

application. This relation is not a perceiver-independent property of an entity taken alone, but rather a conceptualization which has human information processing consequences. That is, it is psychologically defined. Similar ideas about the conceptualization mechanism were presented in terms of affordances by Gibson (1966,1979) and further

developed in the approach of psychological essentialism as discussed by Medin (1989). These approaches to conceptualization, however, do not have clearly defined theoretical constructs which can capture conceptualization mechanisms pertinent to lexical processing.

Langacker's (1987) theory of Cognitive Grammar offers categorizing relationships of schematicity and extension that can gives rise to a number of meanings when applied to different contextual frames. As depicted in Figure 3-3, the abstract common representation 'circular entity' can be conceptualized as a piece of jewelry worn around a finger or as a circular mark, depending on the degree of schematicity required within a given frame of reference. Contexts that require the suspension of certain basic specifications constitute the basis for extensions. For example, the frame of reference for the meaning 'arena', emphasizes particular functional properties and suspends limiting geometric specifications. The basis for metaphorical extensions is the application of abstrations to contextual frames different from those they were conventionalized in (Langacker, 1987; Lakoff, 1987). The most common example of a metaphorical extension is the representation of temporal relations in spatial terms. For example, "behind" has a meaning "in the past" when used metaphorically. While differences between frames of reference have been considered to be the major source of polysemy (Fillmore & Atkins, 1992).

The structural assumption provides a lexical-conceptual basis for the mechanisms which govern lexical processing. Thus, activation patterns between tiers are determined by (1) similarity of other senses to an abstraction, and (2) similarity between frames of reference. Similarity relations between senses can be established at the basic level, where

judgments primarily involve perception and interpretation of our immediate environments. Many relations between concepts are so closely tied to looks and affordances that they seem at first to be perceptually given (Keil, 1987; Mervis, 1987; Markman, 1987). In other words, people adopt an essentialist heuristics; that is, the hypothesis that things that look alike tend to share deeper properties (Medin & Wattenmaker, 1987). Similarity between frames of reference can be established on the basis of common functional properties that can be realized within appropriate contexts. In Figure 3-3, such similarity is captured by greater number of connecting lines between tiers.

Similarity between abstractions and specializations facilitates activation spreading between the senses (represented in bold lines in Figure 3-3), whereas differences between contextual frames inhibit such activation. The greater the functional difference between frames, the longer it takes to establish a relation between the senses of a given item in the network. For example, the abstraction of a circular entity establishes a connection between the specializations 'piece of jewelry worn around finger', 'any circular piece of jewelry', 'circular mark', and 'arena'. Similarity between the domains of application of the first two senses permit an immediate activation of these two nodes in the network. The contextual frames which are used to denote a piece of jewelry and a circular mark are less similar; however, the relationship between the two may be established on the basis of perceptual salience that is reflected in their closer connection to the common abstraction 'circular entity'. Therefore, it should take a somewhat longer time to activate the meaning 'circular mark' following activation of the meaning 'a piece of jewelry'. It requires an even longer time to access the meaning 'arena', because the contextual frame which

constitutes the domain for this meaning bears no resemblance to the other frames of reference.

The proposed representational organization can accommodate effects resulting from instability within the graded structure of a lexical category influenced by linguistic contexts, socio-pragmatic situations, and current goals. These and other linguistic, socio-pragmatic and environmental factors have been demonstrated to be major sources of instability affecting category structure and prototype effects (Barsalou, 1983, 1987; Lakoff, 1987). Thus, retrieval patterns of non-prototypical senses, which are generally characterized by longer response latencies and lower frequency of recall, may be greatly affected by the activation of relevant contextual frames. For instance, the activation of such concepts as 'boxing' and 'tree trunk' may provide a speeded access to less prototypical senses in the RN representation of the lexical item *ring*.

The notion of conceptual structure provides a means of accounting for the instability of graded structure in a lexical category as a result of context effects. The salience of a particular contextual frame affects the prototype status of the senses in a network and, subsequently, defines the activation pattern that follows the presentation of a lexical form in a meaningful context. Context availability is a factor in focusing the activation pattern that follows the presentation of a lexical form. The focus of the activation might even be reduced to a single tier. Hence, the model of conceptual structure mapping predicts that contextual embedding of a lexical form will facilitate a more direct access to the relevant node in the network. Facilitated access can be demonstrated empirically by reduced response latencies and a greater proportion of responses associated with a particular target sense in a given relational network.

The Developmental Assumption

The notion of conceptual structure allows us to consider lexical-conceptual organization as a result of the lexical and conceptual development of an individual speaker. The processing patterns underlying concept formation and language acquisition are of particular importance, since they determine the possible activation patterns in lexical access. The development of a conceptual structure can be depicted in terms of the growth of individual relational networks and inter-network connections following natural routes of lexical and conceptual development.

Conceptual development is one of the facets of human cognitive ability to compare two events, noting discrepancies and categorizing similarities. This ability is fundamental for word and category learning. The use of contrastive contexts has been considered a major means of word learning (Tomasello 1996). A similar principle contributes to developments of relational networks of the acquired lexical items: contrastive context provide information about different senses of the same lexical item. Understanding those contrasts enables a language learner to form a relational network for a given lexical item. The developmental assumption maintains that bilingual speakers possess a number of conceptual structures that may be at different stages of development, as a function of the individual history of the acquisition of the speaker's two languages. Depending on the extent of the primary conceptual development of an individual speaker, conceptual structures may develop simultaneously or sequentially. Thus, bilingual children develop two conceptual structures simultaneously by associating them with particular lexicalization patterns provided by separate concept-acquisition episodes.

Simultaneous formation does not condition parallel development of L1 and L2 conceptual structures (henceforth CS1 and CS2) in early bilinguals.

Lexical and conceptual representations of early bilinguals are particularly context-dependent. Context dependence provides conditions for the complementary development of conceptual structures with some degree of overlap. The non-overlapping areas are associated with impeded ability to relate concepts expressed in different languages. The complementary development of conceptual structures provides a condition for transfer-type errors and code-switching.

Unlike bilingual children, who are in the process of developing both of their conceptual structures, adult L2 learners already have a well-establish conceptual system associated with CS1. In this case they have a solid conceptual system to rely on in the course of CS2 development. Greater reliance on CS1 in L2 learning has been demonstrated by the findings that adult learners are less inclined to use formulaic expressions. Instead of learning conventionalized L2 idiomatic expressions, they apply L1 extensions to L2 representation, producing transfer-type errors (Wong-Fillmore 1976, Yorio 1989). CS2 development in adult bilinguals can be captured in terms of mappings of L2 lexical items on CS1 representations. As L2 learners extend their L2 corpus within the context that provide them with contrastive evidence about L2 lexicalization patterns, CS2 begins to develop. Isolated L2 representations that were initially mapped onto convergent CS1 nodes, begin to evolve their own relational networks that ultimately lead to CS2 formation.

Conceptual Structure Mapping

Similarity in the socio-pragmatic context of concept formation and a common pool of linguistic means ensures a similarity between (not absolute identity of) conceptual structures formed in the same speech community. Conceptual structures developed in different speech communities may differ (1) in the degree of schematization permitted between senses in a network, (2) in the sets of contextual frames that provide bases for the network senses, or (3) in profiling patterns[5].

The first condition can be illustrated by the following example. The concepts 'ladder' and 'staircase' are not differentiated in the Russian language. They share a common abstraction: a means for upward movement. Specifications that pertain to functional differences between a ladder and a staircase can be suspended. Hence, the concepts relate different parts of the network to a single lexical item *lestnica*. Which concept is activated when *lestnica* is heard depends on the functional context, which is very narrowly defined. On the other hand, in English, the functional difference between the two concepts is central and cannot be suspended. As a result, two lexical items are used to communicate these two concepts.

A relational network of the Russian lexical item *probka* can be used to illustrate the second condition. The prototypical sense of this lexical item can be conceptualized in English as 'plug, stopper, cork', whereas in Russian it is a single indivisible

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[5] Cognitive Grammar posits hierarchies of domains to provide the basis for various concepts. The parts of the domains that a linguistic unit invokes are called the *base*. The notion of a *profile* is used to indicate that some facet of the base is raised to a prominent level (Langacker 1988, pp. 53, 59).

conceptualization of a device that keeps liquid in a container. The relational network of the Russian word *probka* is characterized by a considerably larger set of applicable contextual frames. For instance, the common abstraction of the network senses can be extended to denote a traffic jam. Although English borrows terms from the same semantic field to denote congested driving conditions (e.g. bottleneck), the event is conceptualized differently in the two languages. While in English it is conceptualized as a condition associated with a too narrow passage, in Russian it is conceptualized a result of some obstruction in a passage of whatever size.

Linguistic predications in L1and L2 may differ in profiling patterns that are imposed on a base. For example, the Russian word *ruka* denotes a concept that conflates the concepts activated by the English words 'hand' and 'arm'. The contrasting profiling patterns of the English words are evident from the inappropriate pictures evoked by sentences (2) and (4). However, the profiling pattern of the Russian word *ruka* renders the Russian equivalents of all four sentences appropriate.

(1) She has a child in her arms.

(2) She has a child in her hands.

(3) She has a pen in her hand.

(4) She has a pen in her arm.

Note, however, that there are only two Russian sentences involved: *U nee rebenok v rukax* translates both (1) and (2) and *U nee rucka v ruke* translates both (3) and(4). In short, some transfer-type errors may result from the bilingual's failure to recognize contrasts in one-to-many profiling patterns of L1 and L2.

As shown, the conceptual structures of two different languages may have networks which are highly compatible, less compatible, or even incompatible. Compatible areas are associated with perceptually salient domains of human cognition. Thus, the network representation of concrete nouns has been demonstrated to be highly compatible in many languages. The results obtained in semantic priming (Jin & Fischler 1987, de Groot& Nas 1991) demonstrates that a greater cross-linguistic priming effect is characteristic of concrete words, whereas greater language-specific variations are characteristic of abstract words. Incongruities resulting from mapping incompatible areas in two conceptual structures account for performance deficits in bilingual production, e.g. longer response times and lexical transfer.

The proposed model contends that conceptual structure mapping provides a functional account of the lexical-conceptual representation of the bilingual memory. The model does not posit a strict dichotomy of lexical and conceptual level processing. Instead it uses the notion of a structured relational network to capture the intricate relations between lexical and conceptual information. The mapping metaphor represents a link between the two conceptual structures of a bilingual and helps to explain the activation patterns observed in bilingual production.

CHAPTER 4
EXPERIMENT 1: MODIFIED REPLICATION OF THE SHOLL ET AL. (1995) STUDY

The revised hierarchical model of bilingual memory proposed by Kroll and Stewart (1994) maintains that the language-specific lexical representations of a bilingual are linked at both lexical and conceptual levels. Specifically which level is activated depends on the direction of interlanguage connections. If mediation between languages proceeds in the direction from L1 to L2, the languages connect at the conceptual level, where amodal conceptual representations of lexical items are activated. If bilinguals mediate in the direction from L2 to L1, connections between L2 and L1 words are established at the lexical level. Such connections provide direct lexical links between L1 and L2 stores and do not require activation of amodal conceptual representations.

Sholl, Sankaranarayanan, and Kroll (1995) used transfer-appropriate logic to provide support for the configuration of connections outlined in the revised hierarchical model. According to the principle of transfer-appropriate processing, memory performance is a function of the overlap between study and test operations. The revised hierarchical model predicts that conceptual activation should affect bilingual performance when the direction of mediation between bilinguals' two languages proceeds from L1 to L2, but not in the opposite direction. Effects of prior picture naming on translation times from L1 to L2 and from L2 to L1 were examined to provide evidence supporting the types of connections proposed in the revised hierarchical model of bilingual memory. The

results demonstrated that the magnitude of facilitation following picture naming in both L1 and L2 was greater when the translation was performed from L1 to L2 than in the opposite direction. The reported effects were interpreted as resulting from transfer that is possible between the tasks that have similar processing requirements. Translation and picture naming were thoroughly investigated in a number of studies (Potter, So, von Eckhardt & Feldman 1984, Glaser 1992, Snodgras 1993). Both tasks were assumed to share lexical and conceptual processing requirements. As follows from the revised hierarchical model, processing requirements in translation differ, depending on the direction of translation. Since it was proposed that translation from L1 to L2 is a conceptual-level task and translation from L2 to L1 is a lexical-level task, the facilitation observed in L1-to-L2 translation following picture naming was interpreted as evidence of transfer that is possible between conceptually-driven tasks. On the other hand, the absence of any significant effects on L2-to-L1 translation latencies was taken as an indication of a different type of processing, which was assumed to be lexical. In addition, it was suggested that the locus of transfer was not at the level of retrieving the lexical form, because production of picture names had no effect on L2-to-L1 translation latencies.

One purpose of the present experiment was to obtain additional evidence regarding the locus of transfer. Since picture naming provides both conceptual and lexical activation, the observed transfer effects might have resulted from both. It is necessary to determine exactly what effect(s) each of these causes have by itself. We must therefore dissociate lexical and conceptual factors at the encoding stage of the experiment. For this purpose lexical decision and object identification tasks were substituted for picture

naming. In a lexical decision task one should identify whether a string of letters constitutes a word. Presenting translation stimuli in a lexical decision task was supposed to ensure prior activation of the target lexical representations. An object identification task was assumed to provide the same amount of conceptual activation as picture naming (Kroll & Potter, 1984) without the explicit production of a lexical form. In the object identification task reported in the Kroll and Potter (1984) study participants were required to identify whether a drawing represents a real object. However, it is possible that in such a task conceptual representations of easily identifiable objects may not be sufficiently activated. To ensure sufficient activation, an object sorting task was used. In this task all stimuli were unambiguous pictures of common objects. A participant was instructed to decide whether an object could be found in her or his home. Pictures were sorted into three piles according to the type of a decision provided ("yes," "no," and "don't know").

The principles employed in an object sorting task are very similar to the ones used in categorization. Traditionally, categorization was assumed to be a task that could suit this purpose (Dufour & Kroll 1995). Unlike picture naming, categorization does not require the explicit production of a lexical form that is associated with a particular concept. However, categorization can not be considered a purely conceptual task, inasmuch as it establishes a lexical link at a comprehension level. In order to perform this task participants should activate lexical representations of category names. The task may create language bias by using a particular language to name categories. Although it may be argued that providing category names in both languages could constrain the exclusive access to a single lexical store, parallel presentation of L1 and L2 category names could trigger activation of lexical-level connections. In other words, bilinguals may be

encouraged to perform an implicit matching of L1 and L2 lexical representations of a target concept. Nevertheless, language bias may be due to cross-linguistic differences in categorization patterns. This bias is closely linked to culturally- or experientially-bound instances of language use. For example, native speakers of American English tend to put corn in a vegetable category, since one of its most common functions fits the profile of a vegetable, while Russian native speakers would be more inclined to categorize corn as a grain. In a case when a target stimulus may represent different categories in a bilingual's two languages, the availability of one but not the other category name can condition the access to a particular lexical store. Careful selection of experimental stimuli and category names may help to eliminate language bias, yet it would not eliminate implicit activation of lexical-level connections. Hence, an object sorting task could be viewed as a better task to provide sufficient conceptual activation with less lexical interference.

The other purpose of the present experiment was to examine whether transfer was the only factor affecting translation accuracy of the stimuli previously named as pictures. According to the transfer-appropriate logic employed in the Sholl et al. (1995) experiment, translation responses that were facilitated by prior picture naming should be exactly the same as naming responses. Although all experimental stimuli were concrete nouns of high imageability, many of them were polysemous lexemes that could trigger a number of translation responses in both languages. The model proposed here maintains that activation of a particular sense associated with a stimulus lexical item depends on a number of factors such as (1) a bilingual's familiarity with a target sense, (2) its prototype status in a given relational network, (3) differences in relational organization of equivalent lexical items in L1 and L2. The model predicts that transfer from the study

task may not be the only factor affecting bilinguals' performance at test. The choice of a lexical form in translation may be affected by each of the aforementioned factors as well. For instance, if a Russian-English bilingual is not familiar with a target sense (e.g. 'screw nut') of the English stimulus lexical item *nut*, the non-target Russian form *oreh* 'kernel' will be produced in response. Therefore, it is critical to distinguish between translations that are the same as the names activated by primes (henceforth, primed translations) and translations that fail to produce target/primed lexemes, yet could be considered correct responses (henceforth, unprimed translations). Since such a distinction was not made in the original study, it is not clear whether the reported effects could be a result of transfer or could be triggered by other processes. Separate analyses of both overall and primed translation data are required before any substantial claims could be made.

Method

Participants

Twenty-eight Russian-English bilinguals participated in the experiment. All participants were native speakers of Russian. The age of the participants ranged from 18 to 42. On average, these participants had studied English for 11.2 years, and had been in an English speaking environment for 4.7 years. At the beginning of the experimental session, participants were requested to fill out a questionnaire about their language learning experiences and were also asked to evaluate their L2 proficiency. Participants noted their dominance in Russian. They did not consider themselves as balanced bilinguals. They rated themselves at an advanced level for most aspects of L2 production

and at a near-native level in some areas of L2 production and most areas of L2 comprehension. No compensation was offered for participation.

Materials

The base materials were 170 words selected from the Snodgrass and Vanderwart (1980) picture-word norms and 20 non-words generated on the basis of 10 English and 10 Russian words. There were two priming conditions and two translation conditions. Picture primes (40 target and 10 filler pictures) were presented in the object sorting task, and word primes (80 target words: 40 Russian and 40 English, and 20 non-word filler items) were used in the lexical decision task. Eighty 80 Russian and 80 English words were used in each translation condition. Out of 80 translation stimuli, 20 words were previously shown as pictures, 20 words were seen in L1 (Russian), 20 words were presented in L2 (English) and 20 words were new/unprimed stimuli. All translation stimuli were partially counterbalanced across four priming conditions (picture primes, L1 primes, L2 primes, new stimuli/unprimed) and two language conditions (translation from L1 to L2 and from L2 to L1). The experimental stimuli and the conditions in which they were presented are listed in Appendix (Tables A-1 and A-2).

Apparatus

The experiment was conducted on an IBM compatible notebook computer with a 24 cm color active-matrix display. The computer ran a program written in Quickbasic. The instructions and the stimuli were presented in white 0.5 x 0.5 cm letters on black background. Picture stimuli were presented on flash cards. All responses were oral. Responses were audio recorded so they could be later checked for accuracy.

Procedure

Since priming conditions were blocked in the original study (naming in L1 and L2), priming conditions were also blocked in this experiment. Participants were presented with a block of picture primes and a block of word primes before translation. Blocks of picture and word primes were counterbalanced across participants. To ensure proper activation of picture prime stimuli participants had to decide whether an item presented in a picture could be found in their home. They were requested to sort pictures into three piles according to the type of the response they could provide: "yes," "no," "don't know".

In a lexical decision task participants were asked to decide whether a stimulus item constitute an English word, a Russian word or a non-word. Word primes were presented on a computer screen. At the beginning of every trial a fixation point appeared on the screen. It was visible for 1 second and was immediately followed by stimulus presentation. Participants had to press color-coded keys as they made a decision: red for Russian words, green for English words and yellow for non-words. The yellow key was positioned in the center of the keyboard. Left and right assignment of the red and green key was counterbalanced across participants.

As in the original study, translations from L1 to L2 and from L2 to L1 were performed in separate blocks. The order of production language was counterbalanced across participants. Translation stimuli were presented on a computer screen. At the beginning of every trial a fixation point appeared on the screen. It was visible for 1 second and was immediately followed by stimulus presentation. Translation latencies were measured for every stimulus by a timer which was set to go off the moment a

stimulus word appeared on the screen. Participants were instructed to press a green key at an onset of translation production. In case they could not translate, they were asked to press a yellow key, which enabled them to proceed to the next stimuli. There was a one second break before the next trial. Both lexical decision and translation tasks were preceded by a short practice session to ensure a consistent performance at test. Participants were tested individually. The experimental session lasted from 20 to 30 minutes.

Results

The data obtained in the translation task were trimmed according to the same principles as in the Sholl et al. (1995) study; that is, latencies with values greater than 2.5 standard deviations above a given participant's mean response time were excluded from the analysis. Latencies from incorrectly translated items were not included in the set. In addition, an item analysis of translation data was performed. Three stimulus items that received less then 10 % of responses were removed from the analysis because of the lack of data.

Correct responses provided to primed translation stimuli did not always denote the same concepts that were activated by picture and word primes. Although all experimental stimuli were concrete nouns of high imageability, many of them had multiple meanings. Chances of providing unprimed translations were equally high in both directions. For example, the English word *nail* may be translated in Russian as *nogot'* and *gvozd'* to denote a horny growth at the end of fingers and toes, and a pointed piece of metal, respectively. In a like manner, Russian word *lestnica* means both 'ladder' and 'staircase'.

The data obtained in this experiment was analyzed on the overall number of correct translations and on the number of primed translations (i.e. translations of the stimuli that produced primed lexical forms).

Overall Translation Data

Figure 4-1 presents mean translation latencies as a function of the direction of translation (from L1 to L2 or from L2 to L1) and the priming condition (i.e. whether translation stimuli were primed by pictures, L1 word, L2 word or were new/unprimed). Translation latencies for the new items demonstrated greater asymmetry than the asymmetry reported in the Sholl et al. (1995) study and its replication. On average, translation times from L1 to L2 were 433 ms longer than translation times from L2 to L1 (1,933 ms and 1,500 ms respectively).

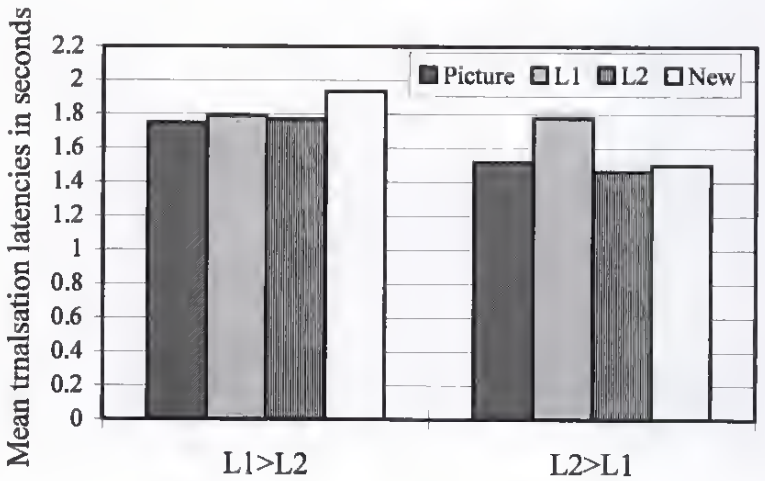

Figure 4-1. Overall translation data: Mean translation latencies as a function of the direction of translation and the priming condition.

A 2 x 4 ANOVA (two directions of translation: L1>L2, L2>L1, and four priming conditions: translation stimuli primed by pictures, L1 and L2 words, and new/unprimed) was performed on mean translation times using participants as random factors. As in the original study, the analysis revealed a significant main effect of the direction of translation, $F(1,216) = 11.3$, $p<.01$. However, the main effect of the priming condition and interaction between the direction of translation and the priming condition were not significant ($p>.5$).

Comparison of translation latencies in both directions showed that L1 primes produced differential effects. Unlike other translation stimuli, the concepts that were previously primed by L1 lexical items did not demonstrate translation asymmetry. A one-way ANOVA with priming condition as a within subject variable were performed on translation latencies for each direction. The effect of the priming condition on translation latencies was not significant in both directions ($p>.5$). Additional paired sample t-tests of translation latencies showed that the effect of priming approached significance only in the direction from L2 to L1. Participants were 317 ms slower when translating stimuli primed by L1 words as compared to the stimuli primed by L2 words ($t=2.06$, $p=.05$). Effects of other conditions were not significant ($p>.05$). Contrary to the results reported in the original study, the L2-to-L1 direction was more sensitive to different priming conditions.

Accuracy data are given in Table 4-1 as a function of the direction of translation and the priming condition. As in the original study, participants were more accurate when translating from L2 to L1 than in the opposite direction. A 2 x 4 ANOVA performed on the accuracy data using participants as random factors demonstrated a significant main effect of the direction of translation, $F(1,216) = 23.23$, $p<.01$. In addition, the analysis

revealed a significant interaction between the direction of translation and the priming condition, $F(3,216) = 9.09$, $p<.01$. The effect of the priming condition was not significant ($p>.5$). A one-way ANOVA with the priming condition as a within-subject variable was performed on accuracy data for each direction. The effect of priming was significant in the direction from L1 to L2, $F(3,108) = 5.82$, $p<.01$, and was marginally significant in the opposite direction $F(3, 108) = 3.93$, $p<.05$. Additional paired sample t-tests revealed that both lexical (L2 word) and conceptual (picture) primes produced equal effects in the direction from L1 to L2 ($t<1$). In L2 to L1 translation, participants were less accurate when translating stimuli primed by pictures than unprimed stimuli or stimuli primed by L2 words ($t=2.68$, $p=.01$ and $t=3.23$, $p=.01$ respectively).

Table 4-1. Proportion of correct translations in different priming conditions.

	Priming condition:			
	Picture	L1 word	L2 word	Unprimed
L1-to-L2	.81	.70	.80	.70
STD	.10	.14	.12	.15
L2-to-L1	.78	.86	.83	.84
STD	.9	.11	.09	.10

Primed Translations

Latencies of unprimed translations were removed from the set of the overall translation data. Responses that did not match L2 picture names or L2 lexical forms presented at study were removed from L1-to-L2 translation data, and, conversely, responses that did not match L1 picture names and L1 word primes were removed from L2-to-L1 translation data. Translation data of new items remained the same as in the

analysis of the overall translation data. On average 2.25 trials were omitted in L1-to-L2 translations, and 2.21 trials were omitted in L2-to-L1 translations in a data set obtained from a single participant. A list of unprimed translations is provided in Appendix (Table A-3).

Table 4-2. A comparison of mean translation latencies in seconds for the overall and the primed translation data. Primed translation latencies are given in parentheses if different from overall translation latencies.

	Priming condition:			
	Picture	L1 word	L2 word	Unprimed
L1-to-L2	1.75 (1.74)	1.79	1.76 (1.78)	1.93
STD	.59 (.58)	.58	.62 (.69)	.67
L2-to-L1	1.51 (1.50)	1.77 (1.78)	1.46	1.50
STD	.37 (.38)	.67 (.69)	.47	.44

Table 4-2 presents a comparison of translation latencies for the overall and the primed translation data sets. As reported in the replication of Sholl et al. (1995), comparison of the overall and primed translation latencies revealed only a negligible difference. A 2 x 4 ANOVA performed on mean translation latencies using participants as random factors showed the effects as reported in the analysis of the overall translation data. There was a significant main effect of direction of translation, $F(1,216) = 11.3$, $p<.01$. The main effect of priming and the interaction between the direction of translation and the priming condition were not significant ($p>.5$). A one-way ANOVA with priming condition as a within-subject variable did not show a significant effect of priming in both directions ($p>.5$).

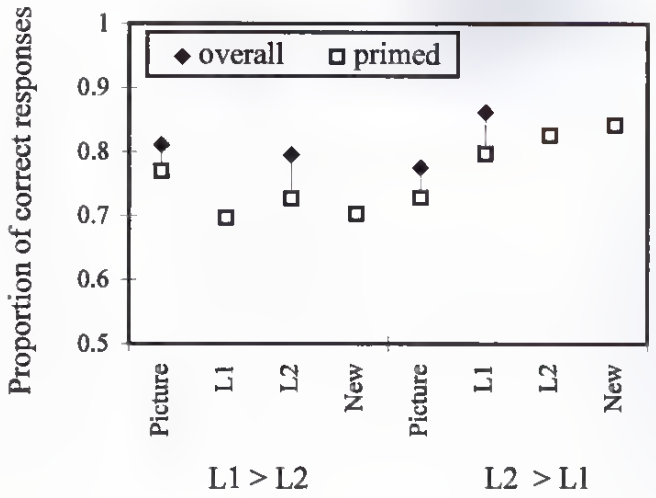

Figure 4-2. A comparison of accuracy values for the proportion of all correct translations and the proportion of primed translations

Figure 4-2 presents a comparison of the overall and primed accuracy data. Data patterns observed in Figure 4-2 suggest that higher accuracy values reported in the analysis of the overall translation data for the stimuli primed by pictures and L2 words in L1-to-L2 translation and L1 words in L2-to-L1 translation were not a result of priming. A 2 x 4 ANOVA was performed on the accuracy data with the direction of translation and the priming condition as within-subject variables. As in the analysis of the overall translation data, there was a main effect of the direction of translation, $F(1,216) = 21.57$, $p<.01$. Interaction between the direction of translation and the transfer condition was also significant, $F(3,216) = 6.11$, $p<.01$. Separate one-way ANOVA with the transfer condition and the direction of translation as within-subject variables were performed on accuracy of the primed translation data. Contrary to the previous analysis, priming effects

were no longer significant in the direction from L1 to L2, $p>.5$, whereas in the opposite direction priming effects became significant, $F(3,108) = 6.45$, $p<.01$.

Discussion

According to the revised hierarchical model, translation from L1 to L2 is a conceptually-driven task and should benefit from prior conceptual activation of translation stimuli. Therefore, translation latencies of the stimuli which were previously presented in the object sorting task should demonstrate a significant reduction of translation latencies as compared to the stimuli presented as L1 and L2 words or the stimuli which did not receive any prior activation. The experimental data reported here do not support this contention. Neither the effect of priming nor the interaction between the priming condition and the direction of translation were significant.

Latencies obtained in this experiment demonstrated a significant translation asymmetry. Translation times for the new items in L1-to-L2 translation were 433 ms longer than in the opposite direction. This asymmetry was even greater than the asymmetry reported in the original study, which was 149 ms. Therefore, it would be reasonable to conclude that bilingual speakers employed in this experiment were dominant in their first language, as was a group of bilinguals in the original study.

The results obtained in the original study demonstrated that English-Spanish bilinguals were concept mediators only in the direction from L1 to L2. On the basis of extensive experimental evidence Dufour and Kroll (1995) proposed that more fluent bilinguals may gradually switch to concept mediation in both directions. According to their proposal, as fluency increases, bilinguals switch to conceptual mediation in both

directions. In such a case translation asymmetry should be significantly reduced and transfer between picture naming and translation should be effective in both directions. According to Sholl et al. (1995), transfer effects are an indication of conceptual level processing during translation. In the Sholl et al. (1995) study transfer between picture naming and translation effected a reversal of the standard translation asymmetry. Unlike the translation latencies of new words that were longer in L1-to-L2 translation than in the opposite direction, L1-to-L2 translation latencies of the concepts that were previously named in L2 were shorter than their L2-to-L1 translation latencies. Such a reversal effect may be significantly reduced in the case of bi-directional conceptual activation during translation resulting from insufficient translation asymmetry. As a result, effects of experimental variables become less transparent in the data of more fluent bilinguals. The latency data which exhibits greater translation asymmetry would be more transparent for transfer effects than the data that does not exhibit such asymmetry. Notwithstanding, this study failed to obtain transfer effects in the latency data.

The lack of a transfer effect in the L1-to-L2 direction in this data suggests that the locus of priming may not be at the conceptual level, as proposed in the original study. Moreover, L2-to-L1 translation latencies demonstrated sensitivity to different types of lexical stimuli in this direction: there was a significant difference between translation latencies produced in responses to the stimuli which were previously presented as L1 and L2 words. Responses to L1-primed words were significantly slower than response to L2-primed words (t=2.06, p=.05). Although sensitivity to differences in lexical stimuli in the direction from L2 to L1 agrees with the assumption that that translation in this direction is performed at the lexical level of processing, it contradicts the conjecture that the locus

of transfer is not at the level of retrieving the lexical form. The leading assumption of the revised hierarchical model (i.e. that translation from L2 to L1 is essentially a lexical-level task) also became problematic for the principle of transfer-appropriate processing. Following the logic of transfer-appropriate processing, prior lexical activation should facilitate performance of the task that requires lexical processing. As shown in the analysis of L1-to-L2 latency data, such facilitation was not obtained. Prior processing of L2 lexical stimuli resulted in a 39 ms facilitation of response times, which was not significant. Contrary to the transfer-appropriate logic, prior exposure to L1 stimuli produced a negative effect: the time to translate the stimuli previously seen as L1 words was 270 ms longer than the time to translate new words. This negative effect remained when latencies of unprimed translations were removed from the data set. Since all translation stimuli were counterbalanced across the priming conditions, the effect was not due to stimuli selection. Although the reliability of this effect is rather questionable, the mere likelihood of this episode questions validity of the assumption that was tested in this experiment.

Additional evidence regarding the locus of transfer comes from analyses of the accuracy data. Accuracy was analyzed on the basis of all correct responses (overall accuracy) and on the basis of responses which produced exactly the same lexical forms as were supposed to be activated by primes (primed accuracy). The effects reported in the analysis of the overall accuracy conform to predictions that follow from the revised hierarchical model. That is, in the direction from L1 to L2, bilinguals were more accurate in their translations of the stimuli that were previously presented as pictures and L2 words, whereas in the opposite direction neither of the priming conditions were

significantly different. Higher response accuracy to the stimuli primed by pictures and L2 words in L1-to-L2 translation could be interpreted as evidence of transfer that occurs in the direction from L1 to L2. However, an itemized analysis of the accuracy data revealed that not all correct translations could result from prior presentation of a prime. For example, in the Russian language, the word *lestnica* is used to denote two concepts that have distinct lexical representations in English ('ladder' and 'staircase'). In translation from L1 to L2 the stimulus *lestnica* was unprimed in one subset of stimuli and was primed by a picture of a ladder, by the Russian word *lestnica* and by the English word *ladder* in other subsets. In L1-to-L2 translation both English words were produced, regardless of the priming condition. In the subsets where the concept of ladder was activated either by a picture or by the English word, "stairs" or "staircase" were considered unprimed responses.

Unprimed responses were removed from the analysis of the primed translations. The analysis revealed that actual effects of priming were the reverse of what was expected: priming effects were significant only in the direction from L2 to L1, and as with the latency data, the effect of transfer was negative in this direction. The combined evidence from the overall and primed accuracy analyses indicate that higher accuracy ratio of responses to primed translation stimuli did not result from transfer, since the proportion of target lexical items produced in response to primed translation stimuli were lower than the proportion of correct translations provided in response to unprimed translation stimuli (see Figure 4-2).

The results suggest that both lexical and conceptual priming may not be considered a reliable factor affecting translation accuracy. Translation accuracy is a

complex notion that is affected by a bilingual's familiarity with patterns of lexical-conceptual organization in the target language. A set of lexical items activated by a particular concept may be different in a bilingual's two languages. A bilingual may not have a sufficient knowledge of L2 lexical-conceptual organization in order to account for the differences. Otherwise, production demands may not require them to discriminate between sets of senses which can be activated by a stimulus lexical item in both languages. Since the translation of isolated stimuli does not require such discrimination, this type of a task may not provide an adequate account of the processes engaged in the activation and retrieval of lexical information in both languages. The use of contextual information along with single word stimuli can help to channel activation in a particular direction, in which case experimental results would not be uncontrollably confounded by other factors. For example, it was shown that use of meaningful contexts at study leads to semantic involvement at test even on such traditional data-driven task as word-fragment completion (Smith, 1991). Thus, memory performance has been demonstrated to be not only the function of the overlap between encoding and retrieval conditions, but also the function of the interaction between task demands and stimulus processing requirements. Since in the Sholl et al. (1995) study the major emphasis was put on the former, the results may not be a comprehensive reflection of bilingual memory performance.

CHAPTER 5
EXPERIMENT 2: REPLICATION OF THE SHOLL ET AL. (1995) STUDY

In the Sholl et al. (1995) experiment picture naming was used at the encoding condition to provide conceptual activation, and translation was used at the test. The results were predicted to demonstrate a transfer between the tasks that share similar processing requirements. Following the representational organization proposed in the revised hierarchical model, picture naming was expected to affect translation times of previously named concepts only in the direction from L1 to L2, because only this direction was proposed to require conceptual activation. The results reported by Sholl et al. (1995) confirmed the prediction. Significant reduction in translation times from L1 to L2 and the absence of thereof in the opposite direction was found to be in agreement with the principle of transfer-appropriate processing. Shorter latencies observed in L1-to-L2 translation of the previously named concepts were interpreted as an indication of transfer which is possible between tasks that require conceptual processing. In addition, the lack of transfer in L2-to-L1 translation following name production in picture naming task was interpreted as evidence suggesting that the locus of transfer is not at the level of lexical form retrieval. The combined evidence was taken as support for the configuration proposed in the revised hierarchical model.

The purpose of this experiment was to replicate the effects reported by Sholl et al. (1995). It is not clear from the analysis reported by Sholl et al. (1995) whether

translations of previously named concepts were matched up to the responses that were produced in the naming task. The analysis of the responses obtained in the Experiment 1 demonstrated that some correct responses produced unprimed translations. As mentioned in Chapter 3, the present model maintains that transfer is not the only factor affecting bilingual performance at test. Therefore an itemized analysis of the translation data is needed to assess the extent of transfer effect on the primed responses.

Method

Participants

Fifteen Russian-English bilinguals participated in the experiment. All participants were native speakers of Russian who had lived in an English-speaking environment for at least 2.5 years (5.2 on average) and had studied English as a foreign language for at least 2 years (3.8 on average) before coming to the US. At the beginning of each experimental session, participants were requested to fill out a questionnaire about their language learning experiences and were also asked to evaluate their L2 fluency level. Participants did not consider themselves to be balanced bilinguals. They rated themselves at an advanced level for most aspects of L2 production and at a near-native level in some areas of L2 production and most areas of L2 comprehension. Participants were not given any compensation for participation.

Materials

The materials were selected according to the same principles described in Sholl et al. (1995). There were 80 pictures selected from the Snodgrass and Vanderwart (1980) norms. Picture names formed a variety of superordinate categories in both English and

Russian. Pictures and their word names were divided into four versions and were partially counterbalanced across conditions and across participants. Half of the materials were presented at study; that is, 20 pictures were used in the L1 naming task and 20 other pictures were used in the L2 naming task. An additional 20 pictures were added to the set as fillers to be used in picture naming: half of them were used in the L1 naming block and half of them were used in the L2 naming block. The remaining 40 picture names were presented as new stimulus items in the translation task: half of them were presented in translation from L1 to L2 and half of them were used in translation from L2 to L1. Except for deliberate repetition of the target picture names in the translation task, no concepts were repeated for a given participant. There were two blocks of translation stimuli. Each block consisted of 10 picture names that were named in L1, 10 picture names that were named in L2, and 20 words that were presented as new items. Stimulus materials and the experimental conditions in which they were used are provided in Appendix (Tables A-4 and A-5).

Apparatus

The experiment was conducted on an IBM compatible notebook computer with a 24 cm color active-matrix display. The experiment ran a computer program written in Quickbasic. The instructions and the stimuli were presented in white 0.5x0.5 cm letters on black background. All responses were oral. Responses were audiotaped so they could be later checked for accuracy.

Procedure

Participants were presented with two blocks of picture stimuli and were asked to name each block of pictures in their first (Russian) and second (English) language. The order of L1 and L2 naming was counterbalanced across participants. Pictures were presented on flash cards. Participants were requested to name them as quickly as they could. Naming latencies were taken for the whole set of pictures. The naming task was immediately followed by translations from L1 to L2 and from L2 to L1, which were performed in separate blocks. The order of language production was counterbalanced across participants. Translation stimuli were presented on a computer screen. At the beginning of every trial a fixation point appeared on the screen. It was visible for 1 second and was immediately followed by a stimulus presentation. Translation latencies were measured for every stimulus by a timer which was set to go off the moment a stimulus word appeared on the screen. Participants were instructed to press a green key at an onset of translation production. In case they could not translate, they were asked to press a yellow key, which enabled them to proceed to the next stimulus. There was a one-second break before the next trial. Each translation block was preceded by a short practice session to ensure a consistent performance at test. Participants were tested individually. The experimental session lasted 10 minutes.

Results

Picture Naming

Mean naming latencies for pictures named in L1 and L2 were calculated. A one-way ANOVA was performed on naming latencies using participants as random factors.

Picture naming language was a within-subjects variable. Bilinguals were more fluent when naming pictures in L1 (1,444 ms) than in L2 (1,849 ms), the observed difference was significant, $F(1,28) = 7.11$, $p<.05$. A one-way ANOVA performed on accuracy data showed that bilinguals were significantly more accurate when naming pictures in L1 (99.33% correct) than in L2 (90.22% correct), $F(1,28) = 18.82$, $p<.01$. Analysis of the naming errors revealed that most errors in L1 and L2 were essentially tip-of-the-tongue phenomena. Participants commented that they were familiar with both L1 and L2 names, but they could not access them at the time. The analysis of the naming data showed that although participants were slightly dominant in L1, they were equally fluent in both languages.

Overall Translation

The data obtained in the translation task was trimmed according to the same principle as in the Sholl et al. (1995) study; that is, latencies with values greater than 2.5 standard deviations above a given participant's mean response time were removed from the set. In addition, latencies from incorrectly translated items were also removed.

Figure 5-1 presents mean translation latencies as a function of the direction of translation (from L1 to L2 or from L2 to L1) and the transfer condition (i.e. whether translation stimuli were previously named as pictures in L1, L2 or whether the stimuli were new). As in Sholl et al. (1995) translation latencies for the new items demonstrated some asymmetry. On average, translation times from L1 to L2 were 86 ms longer than translation times from L2 to L1 (1,541 ms and 1,455 ms, respectively).

A 2 (Direction of Translation: from L1 to L2 and from L2 to L1) x 3 (Transfer Condition: concepts were previously named in L1, in L2 and presented as new) ANOVA was performed on mean translation latencies using participants as random factors.

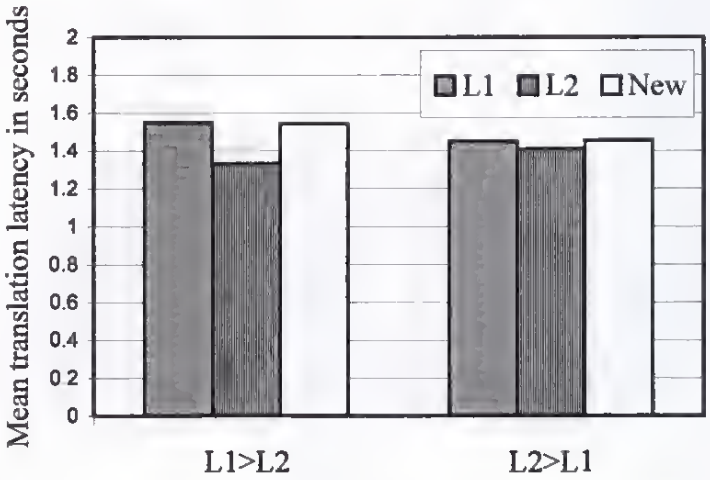

Figure 5-1. Overall translation data: Mean translation latencies as a function of direction of translation and transfer condition. L1 = first language; L2 = second language.

Direction of translation and transfer condition were considered within-subject variables. The analysis did not show significant main effects of the direction of translation or the transfer condition ($p>.5$). Neither did it reveal a significant interaction between the variables ($F<1$).

A comparison of translation times in both directions showed that only the words that were previously named in L2 were characterized by shorter translation latencies when compared to new words. A one-way ANOVA with transfer condition as a within-subject variable was performed on translation latencies for each direction. The effect of

the transfer condition on translation latencies was not significant in either direction ($F<1$). Additional paired sample t-tests of translation latencies did not reveal any significant effects ($p>.1$). The latency data obtained in this experiment did not replicate effects reported by Sholl et al. (1995).

Table 5-1. Proportion of correct responses for presented (primed) and new (unprimed) stimuli. Proportion of correct primed translations are given in parenthesis if different from the overall accuracy values (i.e. all correct translations are considered).

	Priming condition:		
	L1 naming	L2 naming	Unprimed
L1-to-L2 translation	.79	.87 (.75)	.79
STD	.14	.11 (.13)	.12
L2-to-L1 translation	.92 (.85)	.79	.85
STD	.10 (.14)	.16	.08

Accuracy data are given in Table 5-1 as a function of the direction of translation and the transfer condition. As in the Sholl et al. (1995) study, participants were more accurate when translating from L2 to L1 than in the opposite direction. However, contrary to the effects reported by Sholl et al. (1995), an ANOVA performed on accuracy data demonstrated a significant interaction between the direction of translation and the transfer condition, $F(2,78) = 5.43$, $p<.01$. The effects of the direction of translation and the transfer condition were not significant ($p>.5$). A one-way ANOVA with the transfer condition as a within-subject variable was performed on accuracy data for each direction. The effect of the transfer condition was not significant in either direction ($F<1$). Additional paired sample t-tests revealed that the effect of prior naming only approached significance in the L1-to-L2 direction. Participants were more accurate when translating

the concepts that were previously named in L1 than in L2 (t=2.69, p=.01). The difference between the new condition and each of the old conditions (words named in L1 and L2) was not significant (p>.05).

Primed Translation

The latencies of unprimed translations were removed from the set of the overall translation data. Responses that did not match L2 picture names produced in the study were removed from L1-to-L2 translation data, and, conversely, responses that did not match L1 picture names were removed from L2-to-L1 translation data. Translation data of new items remained the same as in the analysis of the overall translation data. On average 1.46 trials were omitted in L1-to-L2 translations, and 1 trial was omitted in L2-to-L1 translations in a data set obtained from a single participant. A list of unprimed translations is provided in Appendix (Table A-6). Table 5-2 presents a comparison of translation latencies for the overall and the primed translation data sets.

Table 5-2. Mean translation latencies in seconds as a function of the direction of translation and the transfer condition (L1 naming, L2 naming, unprimed). Primed translation data are given in parenthesis if different from the overall translation data.

	Priming condition:		
	L1 naming	L2 naming	Unprimed
L1-to-L2 translation	1.55	1.33 (1.34)	1.54
STD	.34	.33 (.35)	.35
L2-to-L1 translation	1.44 (1.42)	1.41	1.45
STD	.35 (.36)	.30	.37

As in the analysis of the overall translation data a 2 x 3 ANOVA was performed on mean translation latencies using participants as random factors. Direction of

translation and transfer condition were considered as within-subject variables. As in the analysis of the overall translation data, there were no main effects of experimental variables. Neither direction of translation nor transfer condition were significant (F <1). There was no significant interaction between the variables (F<1). An additional one-way ANOVA with transfer condition as a within-subject variable did not show any significant effects (F<1).

The primed accuracy data are given in Table 5-1 in parenthesis. A 2 x 3 ANOVA was performed on the accuracy data with the direction of translation and the transfer condition as within-subject variables. As in the analysis of the overall translation data, the effects of the direction of translation and the transfer condition were not significant (p>.5). However, contrary to the previous analysis, interaction between the direction of translation and the transfer condition was no longer significant: p>.5. Separate one-way ANOVA with the transfer condition and the direction of translation as within-subject variables were performed on accuracy of the primed translation data. Neither of the analyses revealed significant effects (F<1). Additional paired sample t-tests did not show any significant effects (p>.5).

Discussion

The results of the experiment did not replicate effects reported by Sholl et al. (1995). Since experimental designs were identical in the original study and in its replica, the effects could have been influenced by differences between the two groups of participants. Analyses of naming data demonstrated a clear difference in L2 proficiency levels between bilinguals employed in both studies. L1 and L2 naming latencies obtained

from English-Spanish bilinguals in the original study demonstrated a significant difference. Absence of such a difference in the naming data of Russian-English bilinguals suggests that Russian-English bilinguals were more fluent in their second language than the English-Spanish group. The smaller difference between L1 and L2 naming fluency could be the reason why translation latencies of the Russian-English group did not demonstrate significant effects of experimental variables. As was mentioned in the discussion of the previous replication, the latency data which does not exhibit significant translation asymmetry would be less transparent for transfer effects. In this case latency data may not be considered a reliable measure of transfer that was predicted to occur between tasks sharing similar processing requirements.

An alternative means of establishing whether there was a transfer between picture naming and translation is to consider accuracy data. A comparison of accuracy data confirmed the assumption that Russian-English bilinguals were more proficient in their second language than bilinguals from the original study. Naming responses produced by Russian-English bilinguals were correct at 90.2%, whereas only 65.8% of names produces by English-Spanish bilinguals were correct. Nonetheless the accuracy data obtained from the Russian-English group demonstrated a significant effect of the direction of translation. In other words, Russian-English bilinguals were significantly more accurate when naming pictures in their first language than doing the same task in the second language. Although participants commented that in most cases their omissions could be viewed as tip-of-the-tongue phenomena, the failure to access L2 names could also be interpreted as an evidence of bilinguals' dominance in their first language. Consequently, the accuracy data can be considered a reliable measure of transfer between

picture naming and translation. The model, however, does not make explicit predictions about accuracy. The model was initially proposed to accommodate latency data, and it is not clear whether the same predictions could be extended to a different domain, i.e. accuracy data.

In the original experiment latency and accuracy data were affected differently by experimental variables. An analysis of latency data showed that only the interaction between the variables was significant, whereas the accuracy data analysis reported only main effects of the experimental variables. The analysis of this experiment's naming data demonstrates that accuracy was more sensitive to differences in L1 and L2 proficiency than latency was. Therefore, the logic that is used with latency data may not apply to accuracy.

Analyses of accuracy data were conducted separately for the overall number of correct translations and for accuracy of primed translations. The overall accuracy data was characterized by a significant interaction between the direction of the translation and the transfer condition. The proportion of correct translations was higher for the words that were previously named in the target language. Such an interaction could be considered an effect of transfer that occurs in both directions. This interpretation conforms to the configuration outlined in the revised hierarchical model. However, an itemized analysis of accuracy data revealed that not all correct translations of previously named concepts were the same as responses produced in picture naming tasks. Therefore, effects reported in the analysis of accuracy data conducted for the overall number of correct translations may not necessarily be a reflection of transfer due to prior picture naming. A separate analysis of primed translations did not reveal any effect of experimental variables on

accuracy data. The reported cases of correct unprimed translation poses a serious problem for the revised hierarchical model. The model does not have a means to account for them mainly because it does not have a component which can handle the finer-grain issues of representation such as polysemy and homophony.

According to the model, translation responses should be primed by prior conceptual activation only when bilinguals employ conceptual level while translating. Therefore accuracy of less fluent/unbalanced bilinguals should be affected in L1-to-L2 translation, whereas translation accuracy of more fluent speakers should demonstrate transfer effects in both directions, or as suggested in Chapter 4, may not show transfer effects in either direction due to the lack of translation asymmetry. The latter was not supported by the data reported in Sholl et al. (1995). The analysis of accuracy data of unbalanced bilinguals demonstrated main effects of the transfer condition in both directions, although it was maintained that bilingual participants were concept mediators only in the direction from L1 to L2. (The latter was drawn on the basis of latency data). However, an unequivocal interpretation of such results is possible only if it is clearly specified whether all correct translations were the same as naming responses produced at the encoding condition of the experiment. It is equally difficult to draw definite predictions about accuracy on the basis of the configuration outlined in the revised hierarchical model. For instance, in L1-to-L2 translation, concept activation by naming picture in L1 does not ensure the accurate connection between a concept node and an L2 word. If a concept is named in L2, the connection between a concept and its L2 representation is activated. However, the configuration of connections proposed in the revised hierarchical model does not imply that a connection between a concept and an L1

word will also be established during L2 naming, in which case, accurate translation is possible only when L1 stimulus will activate exactly the same representation as the one activated in L2 naming. For example, activation of a connection between the concept 'stool' and its L1 lexical representation *taburet* did not always ensure an accurate L1-to-L2 translation (i.e. stool). Responses that were considered as inaccurate were omissions and productions of the basic level term *chair*. On the other hand, an activation of the concept 'moon' in L2 naming did not always help to establish a connection between the concept and its L1 representation *mes'ac*. As a result, a different concept ('month') was activated upon presentation of the L1 stimulus *mec'ac*, and a response provided in L1-to-L2 translation was different from the name produced in L2 naming.

Analyses of the overall and the primed accuracy data revealed that the data cannot be used to support the revised hierarchical model. The effect of transfer reported in the analysis of the overall number of correct responses and the absence of thereof in the analysis of primed data suggests that there are some factors of bilingual performance that were not identified on the basis of the configuration of lexical-conceptual connections promoted by the revised hierarchical model. Effects reported in the accuracy data analyses remain unaccountable mainly because the model does not possess a mechanism that can (1) explain why translation stimuli may not activate the same concepts as the ones activated during picture naming, and (2) predict cases in which prior picture naming fails to prime target translations. One solution to this problem is to define a framework that will recognize issues of language-specific lexical-conceptual organization as central to the issue of lexical access.

CHAPTER 6
RELATION ASSESSMENT: A TEST OF THE PROPOSED MODEL OF CONCEPTUAL STRUCTURE MAPPING

Earlier proposed models of bilingual memory were designed to accommodate experimental evidence arising from specific task demands on single-word stimuli. Latency data obtained from data-driven and conceptually-driven task was taken as evidence of a dissociation between lexical and conceptual processing of word stimuli. However, as demonstrated in the reported replications of Sholl et al. (1995), latency alone can not provide unambiguous evidence of bilingual processing patterns. The present model of conceptual structure mapping was proposed to account for the shortcomings of earlier models. It addresses the stimulus processing requirements associated with language-specific differences in the relational network organization of lexical stimuli. It also addresses instability of prototype effects resulting from graded structure of lexical categories.

The model and its predictions were tested in a relation assessment experiment. In this experiment word pairs to be judged for their semantic relatedness were presented in contextually-embedded (primed) and isolated (unprimed) conditions. The relation assessment task was selected because it can demonstrate prototype effects and degrees of activation spreading arising in the relational organization of the target word stimuli. Prototype effects are generally associated with two things: the senses of a stimulus that exhibit higher perceptual salience or the senses that are most often associated with the

given lexical forms. Hence, a word pair with closely related prototypical senses should yield shorter latencies. Among the causes of this is the immediate availability of the target senses upon the activation of the stimulus's relational organization. Conversely, a stimulus pair with related nonprototypical senses is more likely to generate a greater number of negative judgments or longer latencies in the isolated condition. Contextual embedding affects the graded structure of stimulus lexical categories by restricting prototype effects to domains associated with the activated contextual frames. The activation of a relevant contextual frame eliminates the need for an extensive search in the relational network of a stimulus lexical item. Consequently, it also provides quicker access to the target conceptual representation. Thus shorter response latencies were expected in the primed condition of the experiment.

According to the proposed model the data should demonstrate specific patterns associated with the additional processing demands placed on bilingual speakers. The model maintains that differences in response patterns of bilinguals are conditioned by the activation threshold in the dominant conceptual structure. Therefore a bilingual's performance should provide evidence for the relational organization in the bilingual's dominant conceptual structure. Two predictions were made. The evidence should be particularly salient in the isolated condition. However, since prototype effects associated with a particular organization in the dominant conceptual structure are presumably affected by contextually embedding the lexical stimuli, the data obtained from bilingual and monolingual speakers in the primed condition should reveal comparable patterns of activation.

Experiment 3

Method

Participants

Four groups of monolingual and bilingual speakers participated in the experiment. The participants were students and visiting scholars at the University of Florida. The fluency of bilingual speakers was at the level that fulfills the English language requirement at the University of Florida, which corresponds to a score of 550 or higher on TOEFL (Test of English as a Foreign Language). The monolingual participants, who were taken from a pool of general psychology students, received one experimental credit for their participation in the study; the bilingual participants did not receive any compensation. A group of nineteen native speakers of American English not fluent in any second language and a group of fifteen native Russian speakers fluent in English were tested in the unprimed condition. A group of twelve American English monolingual speakers and a group of thirteen native Russian speakers fluent in English were tested in the primed condition.

Materials

The corpus of stimuli in the unprimed condition included 51 target and 49 filler English word pairs. The target word pairs comprised three groups. These groups were categorized as closely related, distantly related, and unrelated, with 17 pairs in each group. Closely related word pairs were selected in such a way that the prototypical meanings of the two lexical items were closely related (e.g. 'fortune' – 'wealth'). In

distantly related pairs the prototypical meaning of one lexical item was closely related to a non-prototypical meaning of the other lexical item in the pair (e.g. 'limit' – 'ceiling'). In unrelated word pairs none of the senses in the networks of the stimulus lexical items were considered to be related (e.g. 'juice' – 'sock'). The relatedness categorization was based on relatedness ratings of three native speakers of English and were found to be in agreement with primary meanings of the standard variety of American English, as reflected in the New Webster's Dictionary.

The corpus of the stimuli in the primed condition consisted of 51 target and 14 filler English word pairs, which were preceded by 65 sentences. The target word pairs were the same as in the unprimed condition. The sentences used as primes were intended to activate contextual frames, highlighting target conceptual representations. For example, the word pair 'limit' – 'ceiling' was preceded by the sentence "The administration has introduced new ceilings on the value of preferential contracts for minorities." The sentences were selected from authentic English texts available through LEXIS/NEXIS online news service. Stimulus materials used in this and other relation assessment experiments are provided in Appendix (Table A-7).

Apparatus

The experiment was conducted on an IBM compatible notebook computer with a 24 cm color active matrix display. The experiment ran a computer program written in Quickbasic. The instructions and the stimuli were presented in white 0.5 x 0.5 cm letters on blue background.

Procedure

The experiment conformed to a 3 x 2 x 2 mixed factorial design. The independent variable manipulated within participants had three values corresponding to the distance between the prototypical meanings of the words presented in a pair. The word pairs were grouped into three sets: closely related, distantly related and unrelated. Binary language (monolingual vs bilingual) and priming (unprimed vs primed) conditions were distributed between four groups of participants. Reaction times in milliseconds and percent of positive judgments in the relatedness decision were assessed as dependent variables.

In the unprimed condition, the words constituting a pair were presented consecutively. Stimulus and interstimulus intervals were set automatically at 1 second. The timer was set to go off the moment the second word appeared on the screen. Participants were instructed to make judgments of the semantic relatedness between the words. They had to respond as soon as they read and understood the second word in a pair. Response keys marked by "yes" and "no" caps were also color coded, green and red respectively. The "yes" and "no" response keys were located at opposite ends of the computer keyboard to ensure accuracy of responses. Left and right assignment of "yes" and "no" keys was counterbalanced across participants. Participants were instructed to press a white key in the center of the keyboard if they did not know the word(s). Each trial was followed by an automatically set break that allowed the participant to self-pace the experiment. In the primed condition every trial was preceded by a sentence or two. The sentences comprised less than four lines on a computer screen. In order to ensure that participants attended to the sentence stimuli, each sentence was followed by a

comprehension question with four possible answers. Responses were made by pressing the number of a chosen answer. The computer recorded only the correctness of the response to the comprehension question. Both experimental sessions were preceded by a training session which allowed participants to familiarize themselves with the task. Participants were tested individually. The experiment lasted from 10 to 20 minutes in the unprimed condition and from 40 to 50 minutes in the primed condition.

Results and Discussion

The data from participants who had mean reaction times higher than 3 seconds for monolingual speakers or 5 seconds for bilingual speakers and a standard deviation higher than 2 were removed from the set as outlying. To ensure comparable levels of second language proficiency, the data from bilingual speakers who provided "don't know" responses to more than 10 % of the stimulus pairs and who scored lower than 80 % on the comprehension test in the primed condition, were also removed from the set. The remaining data from 17 monolingual and 12 bilingual speakers in the unprimed condition and 8 monolingual and 8 bilingual speakers in the primed condition were analyzed. Analyses of variance (ANOVA) were performed on mean response times and percentage of positive judgments using participants as random factors.

Relatedness judgments

Figure 6-1 presents the percentage of positive judgments as a function of network distance and priming for both bilingual and monolingual speakers. The results demonstrate a highly significant main effect of network distance, $F(2,82)=65.377$, $p<.001$. Although the effect of priming was only marginally significant ($F(1,41)=6.519$,

$p<.05$), the interaction between network distance and priming was significant, $F(2,82)=5.170$, $p<.008$. Priming made some distant meanings more salient and, as a result, the words in the category of distantly related word pairs were judged as related approximately 20% more often in the primed condition than in the unprimed condition by both monolingual and bilingual groups of speakers.

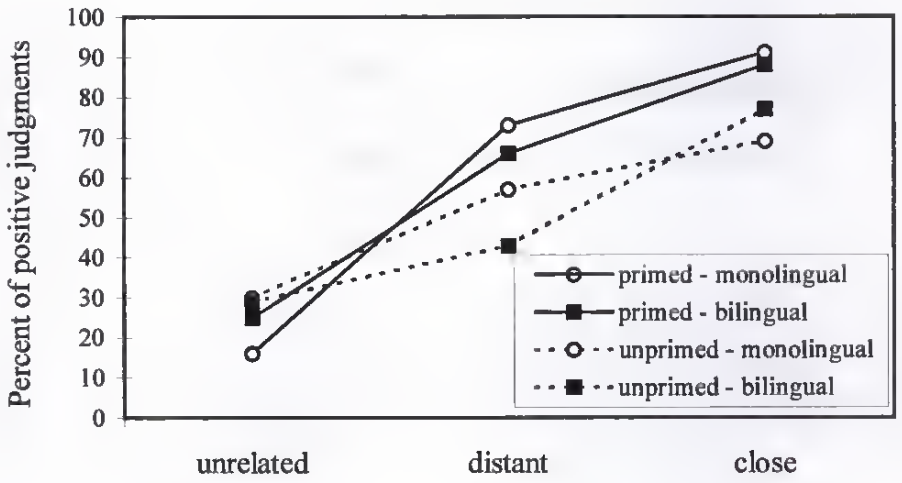

Figure 6-1. Mean percentage of positive judgments as a function of network distance for bilingual and monolingual speakers in unprimed and primed conditions.

There was no main effect of the language variable ($F<1$), indicating that the response types provided by monolingual and bilingual speakers were equivalent. Separate ANOVA were performed on bilingual and monolingual data to discover possible differential effects of distance and priming on different groups of speakers. The analysis of the bilingual data revealed main effects of distance and priming, $F(2,54)=86.587$, $p<.01$, and $F(1,54)=7.668$, $p<.001$ respectively, and a significant interaction between

distance and priming ($F(2,54)=5.594$, $p<.01$). The analysis of the monolingual data demonstrate onlya main effect of distance ($F(2,69)=24.706$, $p<.01$). Although the main effect of language was not significant, the separate analyses demonstrated that relatedness judgments provided by bilinguals were greatly affected by the prior presentation of target lexical items in meaningful contexts in the primed condition. For example, the percent of positive judgments provided by monolingual speakers for the prototypical and nonprototypical meaning in the word pair 'ceiling'-'limit' increased from 75 to 83 following presentation of the prime sentence "The administration has introduced new ceilings on the value of preferential contracts for minorities," while the percent of positive judgments provided by bilingual speakers increased from 27 to 67 percent.

The activation of a particular meaning relation within a precisely defined contextual frame diminishes the negative lexical transfer that results from straightforward mapping of incompatible representations in the conceptual structures of a bilingual. Relatedness judgments obtained in the experiment were shown to be greatly influenced by the availability of contextual cues. Paired-sample t-tests conducted on the data produced in response to distantly related word pairs demonstrated a significant difference in responses produced by bilingual and monolingual speakers in the unprimed condition, $t=2.02$, $p=.05$, and a remarkable agreement between the two groups in the primed condition, $p>.1$.

The processing differences demonstrated between the group of English monolingual speakers and the group of Russian-English bilingual speakers may have two interpretations. They may result either from mapping the two conceptual structures or from the general processing limitations of bilinguals. The proposed model suggests that

conceptual structure mapping should demonstrate processing patterns which reflect language-specific relational organization. The model maintains that the effects of lexical-conceptual organization in the dominant language of bilinguals are most conspicuous when the target lexical items are presented in isolation. As predicted by the model, bilinguals demonstrated results different from the result produced by monolinguals when the target lexical items were not accompanied by any information about their relational organization within the target conceptual structure.

Response latencies

Figure 6-2 presents the mean reaction times as a function of network distance for bilingual and monolingual speakers in unprimed and primed conditions. As predicted, the

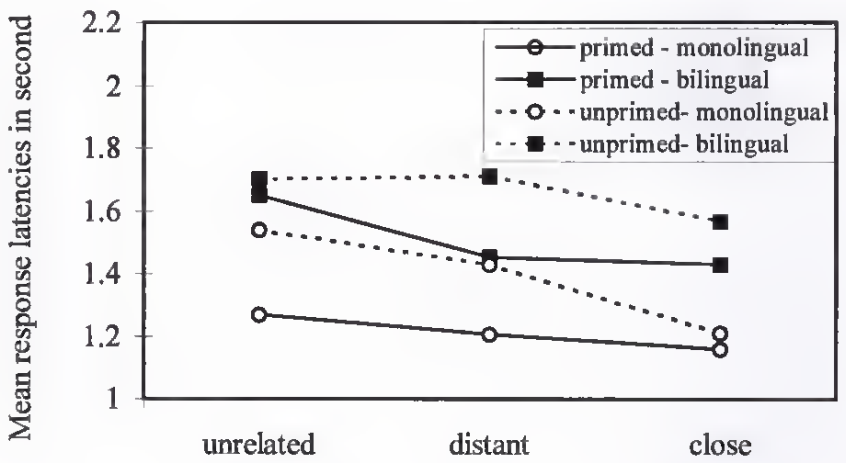

Figure 6-2. Mean response latencies (in seconds) as a function of network distance for bilingual and monolingual speakers in unprimed and primed conditions.

$F(1,41)=7.282$, $p<.001$. Response time latencies of bilingual speakers were approximately 300 ms longer than response time latencies of monolingual speakers in both conditions. The main effect of the language variable supports the assumption that longer latencies produced by bilingual speakers are conditioned by the processing demands placed on bilingual speakers. Processing L2 lexical material requires operation in the conceptual structure characterized by a higher activation threshold. It also requires the suppression of the dominant conceptual structure, which may access a relational network incompatible with the target conceptual organization. As a result, bilinguals require additional time to process L2 stimuli.

The response times also demonstrated a significant main effect of network distance, $F(2,82)=5.635$, $p<.005$.On the average, the participants required 90 ms longer to respond to distantly related word pairs than to closely related word pairs, and they required 80 ms longer to respond to unrelated word pairs than to distantly related word pairs. The results support the prediction that the prototypical meanings of the lexical items are accessed faster than nonprototypical meanings. The paired sample t-test demonstrated statistical significance in response times between closely and distantly related word pairs ($t=2.872$, $p=.06$) and between closely related and unrelated word pairs ($t=3.322$, $p=.02$). The latency difference between distantly related and unrelated word pairs was not statistically significant. This fact indicates that speakers abandon the search when the accessed nonprototypical meanings in the networks of the two lexical items fail to match. Priming reduced the response latencies of bilinguals and monolinguals by approximately 150 and 180 ms, respectively. However, the effect of priming was not statistically significant, $p>.1$. A ANOVA performed on the response latencies of

monolingual speakers demonstrated a main effect of priming, $F(1,69)=7.355$, $p<.01$. As predicted, the latencies of monolingual speakers reflected prototype effects in the unprimed condition by providing significantly longer latencies in response to distantly related word pairs. The prototype effects were significantly reduced following presentation of a priming sentence which activated the contextual frame of a target nonprototypical sense in a distantly related word pair. As a result, nonprototypical meanings were accessed faster in the primed than in the unprimed condition. Analysis of response times produced by bilingual speakers did not show any significant effects. The effect of priming on the response latencies of bilingual speakers was not significant. It could be obscured by additional activation within L1 conceptual structure.

The analyses of response times did not reveal significant interactions between the variables and conditions of the experiment: two-way interactions between language and priming, network distance and language, and network distance and priming were not significant ($F<1$). The three way interaction between language, network distance and priming only approached significance at $F(2,82)=2.193$, $p<.118$. The absence of significant interactions may be due to the ceiling effect resulting from generally large response latencies produced by both monolingual and bilingual speakers. One possible way to eliminate the ceiling effect is to reduce the time of stimuli presentation and the duration of the interstimulus interval. In this experiment the time elapsed from the onset of the first word to the onset of the second word in a pair was 2 seconds. This is a significant amount of time to conduct extensive search in the semantic relational network of the first stimulus word. Shorter presentation times will require participants to attend to the next stimulus before they are able to consider a number of possible meanings

associated with the given word form. In this case response latencies produced by bilingual and monolingual speakers in primed and unprimed conditions may manifest significantly greater differences than are reported with the present design.

Experiment 4

This experiment was conducted to test the hypothesis that the results obtained from bilingual speakers in the unprimed condition are influenced by the dominant conceptual structure. The judgments provided for closely related word pairs were expected to exhibit similar patterns across different language groups for two reasons. First, there is a conspicuous relation between the prototypical meanings of the words in the pairs. There is also the similarity in relational organization pertaining to perceptual salience. Similarly, unrelated word pairs were predicted to demonstrate small differences because of the obvious incompatibility in meaning. The differences in judgments provided for distantly related word pairs were expected to exhibit the patterns conditioned by the relational organization of the conceptual structures of bilinguals' dominant languages. The semantic relations between prototypical and nonprototypical senses in distantly related pairs of the target language may not be present in the relational organization of the equivalent lexical items in bilinguals' dominant languages. Consequently, bilinguals with different dominant conceptual structures were expected to demonstrate distinct relatedness judgments.

Method

Participants

Thirteen native Spanish speakers fluent in English and twelve English monolingual speakers were taken from the pool of general psychology students at the University of Florida. The students received one experimental credit for their participation in the study.

Apparatus and Materials

Apparatus and materials were the same as in the unprimed condition of Experiment 3.

Procedure

The procedure was identical to the procedure in the unprimed condition of Experiment 3. The experiment lasted from 10 to 15 minutes.

Results and Discussion

The results obtained from the groups of Spanish-English bilinguals and English monolinguals were analyzed together with the results obtained from Russian-English bilinguals in the unprimed condition of Experiment 3.

A 3x3 mixed factorial design was used in the analysis the data. As in Experiment 3, the within-subject independent variable had three values corresponding to the distance between the prototypical meanings of the words in a pair, i.e. closely related, distantly related, or unrelated. The language variable (dominant language) was distributed between the three groups of English, Russian and Spanish native speakers. Reaction times in

milliseconds and the percent of positive judgments in relatedness decisions were assessed as dependent variables.

The data were trimmed according to the criteria adopted in Experiment 3. The remaining data from 8 monolingual English speakers, 10 Spanish English and 12 Russian-English bilingual speakers were analyzed. ANOVA was performed on mean reaction times and percentage of positive judgments using participants as random factors.

Relatedness Judgments

Figure 6-3 demonstrates the percentage of positive judgments as a function of network distance for the three groups of speakers. The results demonstrated a highly significant main effect of the network distance, $F(2,81)=88.850$, $p<.001$. Although the

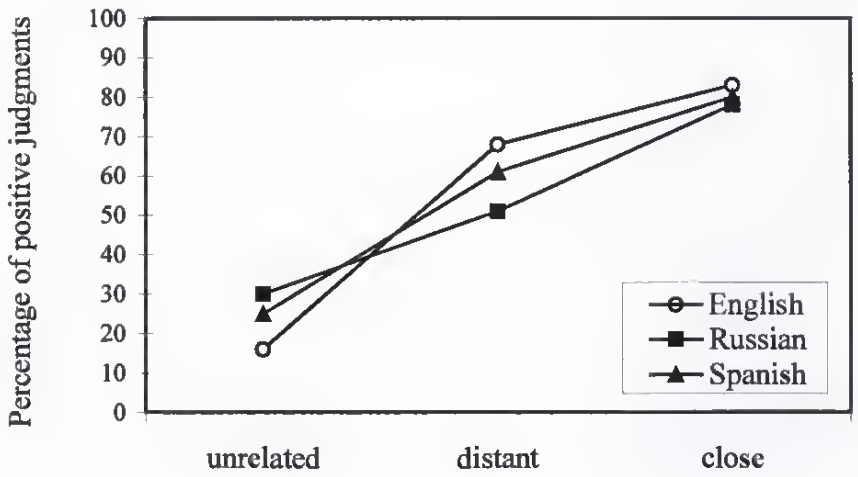

Figure 6-3. Mean percentage of positive judgments on word meaning relatedness as a function of organizational differences in conceptual structures of bilingual and monolingual speakers. (English = English monolinguals, Russian = Russian-English bilinguals, Spanish = Spanish-English bilinguals)

analysis of positive judgments on word relatedness demonstrated the effect of language as non-significant, paired sample t-tests demonstrated that the speakers of the three languages provided different judgments about word relatedness in pairs. Thus, the tests demonstrated statistical significance in judgments provided by English monolinguals and Russian-English bilinguals for unrelated and distantly related word pairs (t=1.936, p=.08, and t=-2.587, p=.02, respectively). The responses of Russian-English and Spanish-English speakers revealed marginally significant difference in their judgments for only distantly related word pairs (t=1.622, p=.1). The judgments of distantly related words provided by English monolinguals and Spanish-English bilinguals only approached significance at t=-1.00, p=.1.

The absence of a significant difference in the judgments of English monolinguals and Spanish-English bilinguals as compared to the difference observed in the judgments of English monolinguals and Russian-English bilinguals can be a result of greater similarity in the relational organization of the stimulus English lexical items and their Spanish equivalents. The greater differences in responses of English monolinguals and Russian-English bilinguals can also be attributed to significantly less extensive experience with the L2 conceptual structure. Unlike Russian-English bilinguals, Spanish-English monolinguals attended high schools in the US and considered themselves to be equally fluent in both languages. One may argue that the latter may serve as counter-evidence for the hypothesis being tested; that is, the differences in judgments of different language groups reflects the proficiency level of bilingual speakers. However, both bilingual groups produced comparable response latencies (Figure 5-4), which were significantly longer than the latencies produced by monolingual speakers. The combined

evidence suggests that proficiency is only one of the factors affecting bilingual performance. Another factor is distinct relational organization within the conceptual structures of a bilingual's two languages. As predicted, the major differences were demonstrated in the relatedness judgments of the distantly related word pairs. These differences and the marginally significant interaction between language and distance variables ($F(4,81)=2.382$, $p<.5$) support the assumption that language-specific relational organization influences the performance of bilingual speakers and therefore should not be disregarded by models of bilingual memory.

Response latencies

Figure 6-4 presents the mean response times as a function of the semantic network distance for bilingual and monolingual speakers. As in Experiment 3, the response times demonstrated a main effect of language in the between-subject condition, $F(2,81)= 12.440$, $p<.01$. The reported significance of the language variable was due to a great difference between the response times of bilingual and monolingual speakers. The response latencies of bilingual speakers were approximately 650 ms longer than the response latencies of monolingual speakers. The paired sample t-tests between the response latencies of Russian-English and Spanish-English bilinguals were performed to investigate whether language-specific organization causes differences in the response latencies of bilingual speakers. The tests did not reveal significant differences in response times of the two bilingual groups. This may be due to an overall increase in response times associated with second language processing. Unlike monolingual speakers, bilingual speakers require additional processing time to recognize the differences between

the semantic structures of the two languages and to suppress the dominant language in cases where its structure does not coincide with the structure of the language being used.

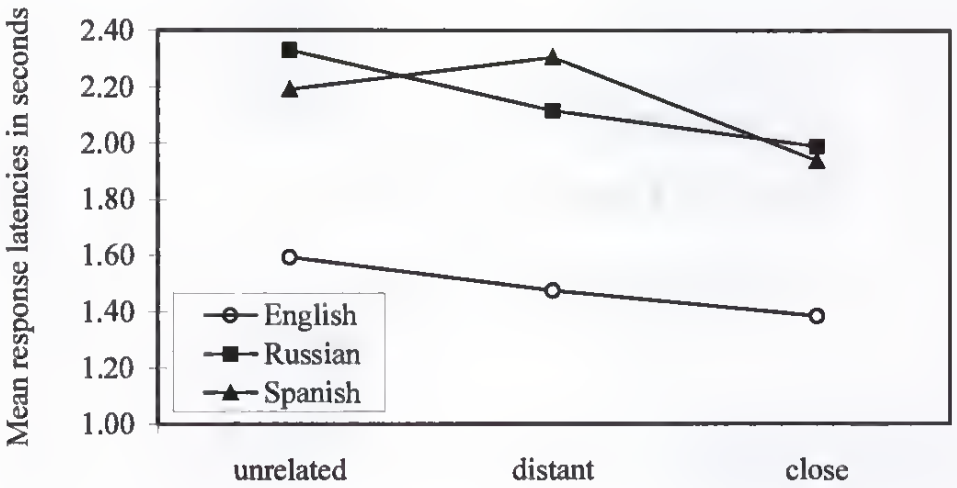

Figure 6-4. Mean response latencies (in seconds) as a function of organizational differences in conceptual structures of bilingual and monolingual speakers. (English = English monolinguals, Russian = Russian-English bilinguals, Spanish = Spanish-English bilinguals)

The effect of network distance was not significant ($p>.5$). The paired sample t-test between the values of the semantic network distance variable demonstrated statistical significance only in the response times of Spanish-English bilinguals between closely and distantly related word pairs ($t= 2.235$, $p=.01$). The latency differences between other conditions were not statistically significant. The analyses of response times did not reveal significant interactions between language and distance variables. As suggested earlier, the fairly long stimulus and inter-stimulus intervals (totaling 2 seconds) might have been why

some effects were not significant. Shorter stimulus and interstimulus intervals may not provide enough time for participants to explore the semantic networks of the stimulus lexical items. Furthermore, bilingual speakers may not have enough time to recognize differences in the lexical-conceptual organization of L1 and L2 conceptual structures. Therefore, experimental results may exhibit greater language-specific differences in both relatedness judgments and latency data produced by monolingual and bilingual speakers.

Experiment 5

This experiment was conducted to examine whether shorter stimulus and inter-stimulus intervals would reveal greater language-specific differences in the data of bilingual and monolingual speakers. In addition, in the primed condition an intervening comprehension task was removed to obtain more salient priming effects.

Method

Participants

Twenty seven monolingual speakers of American English and 38 Russian-English bilinguals participated in the experiment. All Russian-English bilinguals were native speakers of Russian who had lived in an English-speaking environment for at least 3.5 years (6.2 on average) and had studied English as a foreign language for at least 2 years (5.8 on average) before coming to the US. The age of the participants ranged from18 to 39. At the beginning of each experimental session, bilingual participants were requested to fill out a questionnaire about their language learning experiences and were also asked to evaluate their L2 proficiency. Participants noted their dominance in Russian. They did

not consider themselves as balanced bilinguals. They rated their second language proficiency at an advanced level for most aspects of L2 production and at a near-native level in some areas of L2 production and most areas of L2 comprehension. No compensation was offered for participation.

Materials

Two hundred word pairs were generated by the experimenter on the basis of the stimulus materials used in the pervious relation assessment experiments. Sixteen native speakers of American English who did not participate in the experimental session were asked to rate the meaning relatedness of the words in a pair. Ratings were performed on a seven-point scale. The maximum value (7) was used to denote the greatest relatedness, and the minimum value (1) was used to indicate the absence of such a relationship. Stimulus materials were selected on the basis of rating results. Forty word pairs rated 5 or higher with standard deviation of less than 1.5 were selected as the group of closely related words. Forty word pairs rated 2 or lower with a standard deviation of less than 1.5 were selected as the group of unrelated words. A group of distantly related words comprised forty word pairs with a mean rating between 2.5 and 4.5 and with standard deviation higher than 1.5. In each group, there were thirty target and ten filler word pairs.

A priming sentence was provided for each stimulus pair. The sentences were selected from authentic English texts available through the LEXIS/NEXIS online news service. The sentences comprised less than four lines on a computer screen. The sentences were not rated according to their potential to prime particular relationships between the words in a pair. The stimulus materials were divided into two sets with an equal number

of unrelated, closely and distantly related words in each set. Unrelated, closely and distantly related words appeared in random order. Both sets were presented to all participants. The sets were counterbalanced across priming conditions in such a way that half of the participants responded to set I in the unprimed condition and to set 2 in the primed condition, while the other half of the participants responded to set 2 in the unprimed condition and set I in the primed condition.

Apparatus

The apparatus was the same as in Experiment 3.

Procedure

The experimental design was the same as in Experiment 3. The stimuli were presented in two blocks. In the first block the stimuli were given in the unprimed condition, and in the second block the stimuli appeared in the primed condition. There were 60 trials in each condition.

In the unprimed condition a fixation point was shown on the screen at the beginning of every trial. It was visible for I second and was immediately followed by the stimulus. The first word in a pair was visible for 340 ms and was followed by the second word after a 60 ms inter-stimulus interval. The timer was set to go off the moment the second word appeared on the screen. Participants were instructed to press color-coded keys as they made a decision: green for 'yes' responses, red for 'no' responses, and white if they did not know the word(s). The white key was positioned in the center of the keyboard. Left and right assignment of the red and green keys was counter balanced

across participants. There was a one-second break before the next trial. On average, it took about five minutes to complete the task in the unprimed block.

In the primed condition every trial was preceded by a sentence or two. The sentences comprised less than four lines on a computer screen. Participants were instructed to read a sentence at a comfortable speed. They could proceed to an experimental trial by pressing the space bar. The experimental task and the procedure were the same as in the unprimed condition.

Both conditions were preceded by a short practice session to ensure consistent performance in the test. Participants were tested individually. The experimental session lasted from 25 to 30minutes.

Results and Discussion

Latencies with values greater than 2.5 standard deviations above a given participant's mean response time were excluded from the analysis. Data sets of the participant who did not respond to more than 20 % of trials (including those that were removed when the latency data was trimmed) were not included in the analysis. The remaining data from 36 bilingual and 26 monolingual speakers were analyzed. Half of the data were obtained in response to stimulus set 1 and the other half was produced in response to stimulus set 2. Since the purpose of the experiment was to demonstrate language-specific and context effects on word stimulus processing, ANOVA were performed on the same set of stimuli using participants as random factors. As a result, separate analyses were performed for each stimulus set.

Stimulus Set 1

Figure 6-5 presents the proportion of positive responses on word meaning relatedness as a function of organizational differences in conceptual structures of bilingual and monolingual speakers. A 3 x 2 x 2 ANOVA was performed on proportion of positive responses using participants as random factors. As predicted, the analysis

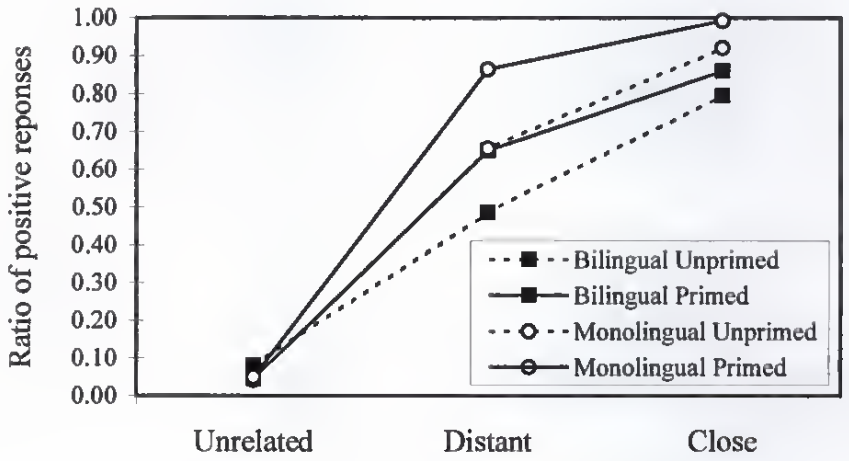

Figure 6-5. Stimulus set 1: Proportion of positive responses on word meaning relatedness as a function of organizational differences in conceptual structures of bilingual and monolingual speakers.

demonstrated significant main effects of distance and language ($F(2,174)=303.82$, $p<.01$ and $F(1,174)=7.40$, $p<.01$, respectively). The effect of priming only approached significance, $F(1,174)=4.20$, $p<.1$;). Two-way interactions between distance and language, distance and priming, and language and priming, and a three-way interaction

between distance, language and priming were also significant ($F(2,174)=9.29$, $p<.01$; $F(2,174)=10.89$, $p<.01$; $F(1,174)=622.04$, $p<.01$; and $F(2,174)=7.19$, $p<.01$; respectively). As in Experiment 3, the responses of bilingual and monolingual speakers were equally affected by priming. The positive judgments provided for distantly and closely related words were significantly facilitated by the prior activation of a relevant contextual frame. Facilitation was greater in responses to distantly related words. On average, there was an 18 % increase in positive judgments provided for distantly related words as compared to a 7 % increase in positive judgments provided for closely related words. The proportion of positive responses to unrelated words was not affected by priming. The findings provide additional evidence for a network configuration as adopted by the proposed model. Since the meaning relation in closely related word pairs exists between prototypical senses, the relationship can be easily established, even when the lexical items are presented in isolation. For distantly related words, the relation exists between non-prototypical meanings and may not always be established without sufficient activation of a relevant contextual frame. Therefore, contextual priming should be especially beneficial for distantly related word pairs. On the other hand, contextual priming should not affect decisions provided in response to unrelated words. Presumably this results from the fact that the senses in the relational networks of such lexical items cannot be used to establish a relation in meaning.

The results also demonstrated greater language-specific differences. Although only English stimuli were presented, the responses of Russian-English bilinguals suggest a substantial activation of L1 lexical-conceptual organization. The relations between L2 words might be obscured because of a distant or nonexistent relation between equivalent

L2 lexical items. For example, the meaning relations between closely related words in pairs such as 'watch' - 'guard', 'sharp' - 'clever', 'drain' - 'empty', are not as easily established between the Russian equivalents of the individual lexical items. Distant meaning relations between words in pairs such as 'shoulder' - 'edge', 'bug' -'defect', 'bed' - 'foundation', 'foot' - 'base' do not exist between the Russian equivalents of these lexical items. As a result, the proportion of positive responses in the bilingual data was significantly lower than the proportion of positive responses in the monolingual data. Furthermore, the magnitude of contextual effects was different in the data of the two language groups. The latter was reflected in a highly significant interaction between language and priming. Positive responses of monolingual speakers to distantly related words demonstrated a 21 % increase in the primed condition as compared to a 16 % increase reported in the data of Russian-English bilinguals.

Figure 6-6 presents mean response latencies of bilingual and monolingual speakers as a function of priming and network distance. A 3 x 2 x 2 ANOVA performed on mean response latencies using participants as random factors demonstrated that effects of distance, language and priming were not significant ($p>.5$). Although two-way interactions between distance and language, and distance and priming were not significant ($F<1$), an interaction between language and priming was significant, $F(1,174)=9.56, p<.01$. A three-way interaction between distance, language, and priming was not significant ($p>.5$). As predicted, the latency data was also affected by shorter stimulus and inter-stimulus intervals. As compared to the latency data reported in Experiments 3 and 4, there was no significant difference in the latencies of monolingual and bilingual speakers. It may be argued that the latency effect could be a function of

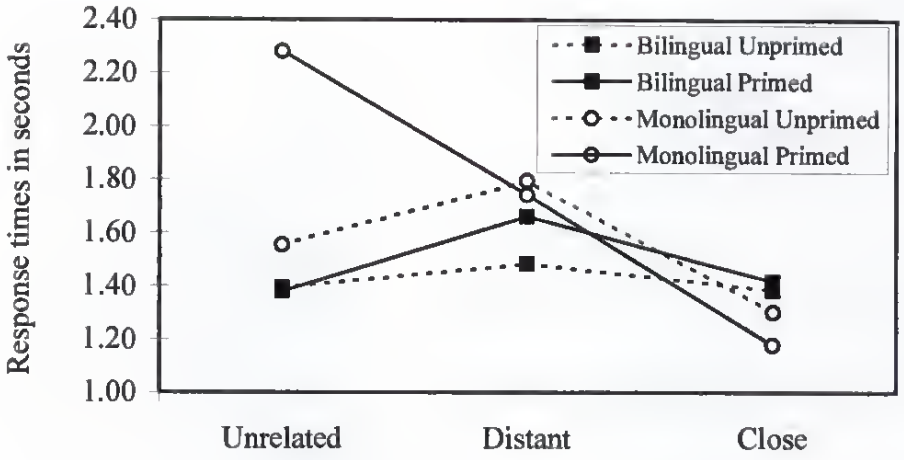

Figure 6-6. Stimulus set 1: Mean response latencies of bilingual and monolingual speakers as a function of priming and network distance.

bilingual fluency; that is, more fluent bilinguals may produce latencies comparable to the latencies of monolingual speakers. Nonetheless, fluency cannot be the only factor affecting the latencies of bilingual participants. As shown in Experiment 4, regardless of the difference in L2 fluency, Russian-English and Spanish-English bilinguals produced equivalent latencies. Therefore, it is reasonable to assume that the shorter response latencies were triggered by shorter stimulus and interstimulus intervals. Since shorter presentation times did not provide an opportunity for a thorough network search, responses of bilingual and monolingual speakers demonstrated more salient language-specific and contextual effects as compared to the data reported in Experiments 3 and 4, where longer response latencies were associated with less conspicuous language-specific and contextual effects. Furthermore, contrary to the findings reported in Experiments 3

and 4, response latencies of both bilingual and monolingual speakers were slightly longer in the primed condition than in the unprimed condition. A slight increase in processing times in the primed condition might be due to a shorter break between the presentation of a sentence prime and a stimulus word pair. Since an intervening comprehension task was not used in this experiment, the relation between a prime and a stimulus word pair became more apparent. Some effects reported in the latency data might reflect a strategy adopted by the participants. Once the participants noticed that context could help to establish the meaning relation between word stimuli, they were compelled to discover a meaning relation in all pairs. The longer latencies produced by monolingual speakers in the unprimed condition in response to unrelated stimuli could be due to such strategic processing.

Stimulus Set 2

Figure 6-7 presents the proportion of positive responses on word meaning relatedness as a function of organizational differences in the conceptual structures of bilingual and monolingual speakers. A 3 x 2 x 2 ANOVA was performed on the proportion of positive responses using participants as random factors. The analysis demonstrated significant main effects of distance and language ($F(2,174)=364.51$, $p<.01$ and $F(1,174)=17.93$, $p<.01$, respectively). The effect of priming was only marginally significant, $F(1,174)=5.50$, $p<.05$;). Two-way interactions between distance and language, distance and priming, and language and priming, and a three-way interaction between distance, language and priming were also significant ($F(2,174)=19.58$, $p<.01$; $F(2,174)=25.79$, $p<.01$; $F(1,174)=762.68$, $p<.01$; and $F(2,174)=16.83$, $p<.01$;

respectively). Contrary to the data obtained for set 1, the responses of monolingual speakers to set 2 demonstrated a negative priming effect. That is, the proportion of positive responses in the unprimed condition was greater than in the primed condition. According to the proposed model, such an effect could be due to the activation of incompatible contextual frames. In other words, target relations between word stimuli were obscured by the contexts provided.

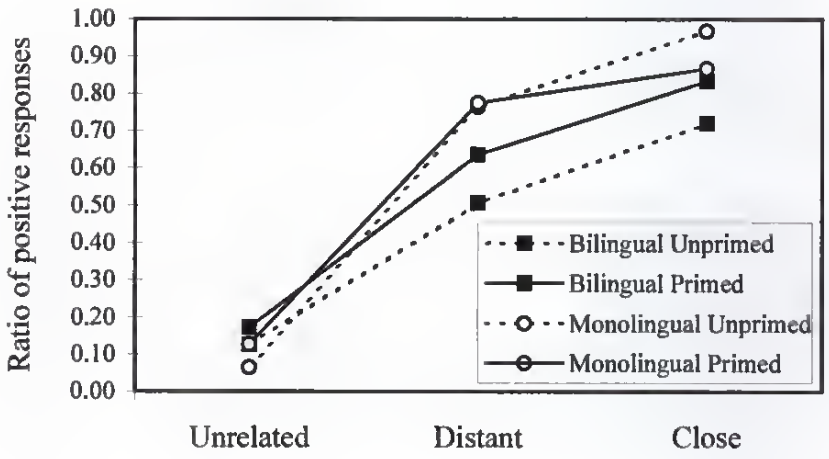

Figure 6-7. Stimulus set 2: Proportion of positive responses on word meaning relatedness as a function of organizational differences in conceptual structures of bilingual and monolingual speakers.

A post hoc rating of sentence stimuli was performed by fifteen native speakers of American English in order to uncover any incompatibility between the contextual frames activated by priming sentences and the target meaning relations. Only the sentences that were used to prime meaning relations between closely and distantly related words were

rated. The sentences were rated on a seven-point scale according to the degree of facilitation they could provide. The maximum value (7) was used to indicate maximum facilitation, and the minimum value (1) was used to denote the lack of any facilitation. On average, set 1 and set 2 were rated at 5.14 and 4.58, respectively. A t-test performed on the two means demonstrated a significant difference between the values assigned to the sentences in the two sets, $t = 2.669$, $p<.02$. As follows from the model and the analysis of priming sentences, the negative effect of priming reported for stimulus set 2 was due to the greater number of sentences that activated contextual frames incompatible with the target meaning relations.

Unlike the monolingual group, Russian-English bilinguals demonstrated a positive priming effect. Nonetheless, the responses of bilingual and monolingual speakers demonstrated greater compatibility in the primed condition than in the unprimed condition. This fact supports the prediction that the data obtained from bilingual and monolingual speakers in the primed condition should reveal comparable patterns of activation.

Figure 6-8 presents mean response latencies as a function of priming and network distance. A 3 x 2 x 2 ANOVA performed on mean response latencies using participants as random factors demonstrated that only the interaction between language and priming was significant, $F(1,174)=10.02$, $p<.01$. The effects of other variables and their interactions were not significant ($p>.5$). As with the relatedness judgments, the latency data of bilingual and monolingual speakers demonstrated greater compatibility in the primed condition. In the unprimed condition, the processing patterns of bilingual and monolingual speakers were influenced by dominant conceptual structures. Conversely, in

the primed condition the processing patterns were constrained by activated contextual frames. This fact provides additional support for the assumption that embedding the lexical stimuli in a context reduces the prototype effects associated with a particular organization within the dominant conceptual structure.

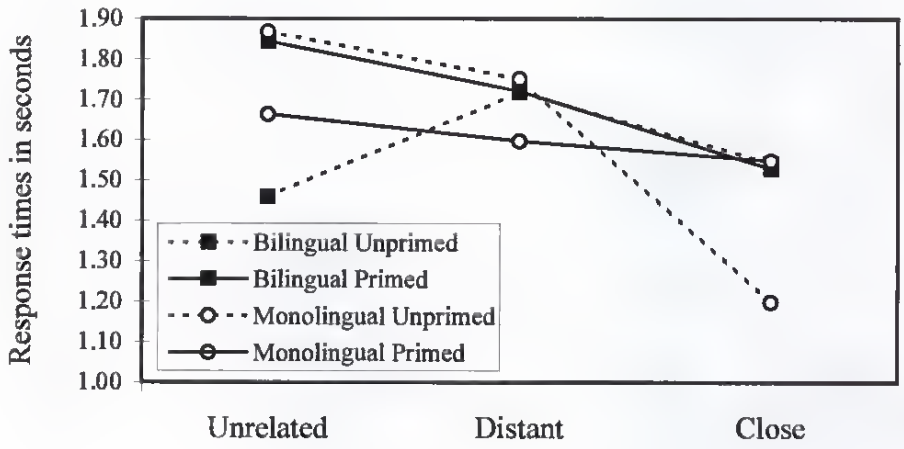

Figure 6-8. Stimulus set 2: Mean response latencies as a function of priming and network distance.

The relation assessment experiments reported here were conducted to evaluate the relational network approach proposed for the model of conceptual structure mapping. Relational networks were demonstrated to be sensitive to the factors causing instability in the graded structure of lexical categories. The relational network organization of the bilingual lexicon constitutes a dynamic structure able to accommodate language-specific and language-independent patterns of bilingual production.

CHAPTER 7
GENERAL DISCUSSION

The model of conceptual structure mapping was proposed to provide an alternate approach to bilingual lexical and conceptual representation. In particular, it was designed to account for the activation patterns in the memory of bilingual speakers which can not be accounted for by the models that maintain a strict dichotomy between lexical and conceptual levels of processing. The proposed model contends that the patterns of lexical and conceptual activation in bilinguals are largely determined by an interaction between language specific lexical-conceptual representations. Such interaction is a function of a number of structural and developmental factors. The role of these factors is explicated in the structural and developmental assumptions of the model.

The structural assumption is elaborated on the basis of the conceptual structure notion that offers a means of accounting for the prototype effects that arise in the graded structures of lexical categories in various socio-pragmatic and functional contexts. The developmental assumption offers a means of accounting for the differences observed between the performances of more and less fluent bilinguals. A bilingual has conceptual structures associated with L1 and L2, which I call CS1 and CS2. The mapping metaphor describes CS2 development as a process of mapping L2 lexical items onto converging conceptual representations in CS1. CS2 development is a result of the development and expansion of relational networks and inter- network connections. Relational networks of

individual lexical items evolve when a lexical item is consistently used in different contextual frames. Areas in CS1 and CS2 that are mutually incompatible have been demonstrated to be the major reason for production deficits such as negative transfer and longer response latencies.

Since the notion of conceptual structure is central to the problems of lexical-conceptual activation, an experimental data analysis without a detailed account of the bilinguals' response types is incomplete. As demonstrated in the experiments reported here, a quantitative analysis of latency and accuracy data do not provide adequate evidence of the processes that govern lexical and conceptual access in the bilingual memory. Thus, in the first replication of the Sholl et al. (1995) study, separate analyses of the overall and primed responses in the translation data provide discriminative results. Since the analysis of the primed accuracy did not reveal any effects of priming, the effects reported in the overall data analysis can not be interpreted as transfer from picture naming to translation. Similarly, an analysis of the primed accuracy data in the modified replication of the Sholl et al. (1995) study demonstrates that the inhibitory effect in L1-to-L2 translation following the presentation of L1 word primes was not a result of transfer. The combined evidence from the two experiments can not be accounted for by previous models. This inability results from the fact that they do not consider tbe development of relational network organization in a bilingual's two languages as central to the issues of lexical and conceptual processing. Such models do not possess the theoretical constructs that account for unprimed responses and predict the conditions of their occurrence.

According to the structural assumption offered in the proposed model of conceptual structure mapping, lexical items are related to many frames and may activate a

whole network of senses. Inasmuch as bilinguals' conceptual structures exhibit differences in their lexical-conceptual organizations, there is a possibility of obtaining a number of responses to a single translation stimulus. As a result, bilinguals may provide responses different from the primed (or target) lexical forms. Conditions for the production of unprimed responses can be elaborated on the basis of both the structural and the developmental assumptions. The structural assumption provides a functional construct (i.e. a frame) to demonstrate that the development of a relational network organization is a result of lexical items' use in contrastive socio-pragmatic and functional contexts. The activation threshold of a particular sense in the relational network of a lexical item depends on (1) the degree of a speaker's familiarity with the given usage, (2) the stability of the graded structure of the given lexical category, (3) representational differences in the relational network, or differences in weights assigned to different frames in the graded structure of the lexical category in CS1 and CS2. The relation between the specified factors is implicational. That is, if a speaker is not familiar with a particular sense, other factors do not apply, and if the graded structure of the acquired lexical category is highly stable, language-specific differences may not produce a significant effect. For example, the English word *nail* may be translated in Russian as *nogot'* and *gvozd'* to denote a horny growth at the end of fingers and toes, and a pointed piece of metal, respectively. If Russian-English bilinguals were familiar with the former sense, but not with the later sense, the Russian lexical representation *gvozd'* ('pointed piece of metal') would not be activated at all. Since the latter sense is not associated with highly stable prototype effects in the relational network of the English lexical item *nail* (i.e. its activation depends on availability of a relevant contextual frame), its activation

threshold in the Russian conceptual structure can be attenuated by differences in the relational organization of English and Russian lexical categories.

The proposed implicational relation between developmental and structural factors may be criticized on the grounds that it may lead to highly individualized descriptions, whereas the objective of any theoretical analysis is to capture a general trend. However, it is important to note that early stages of conceptual structure development are inherently idiosyncratic, because language acquisition episodes reflect personal language acquisition experiences of an individual. Thus, a CS2 of a novice L2 learner constitute a set of isolated lexical representations that are mapped onto converging nodes in CS1. Since only one particular sense in a given relational network is acquired, novice bilinguals may demonstrate greater variability in their responses to single word stimuli. Growing experience with L2 provides a learner with a number of contrastive contexts that enable a novice bilingual to develop relational networks and inter-network connections for the representation of a word. As CS2 evolves, a bilingual's familiarity with a variety of senses in any given relational network will increase. Hence, bilingual production will be less susceptible to individualized developmental factors and more open to prevalent structural constraints, such as graded structure stability and language-specific differences in representational organizations of CS1 and CS2.

One of the major issues addressed by the model proposed here is that the patterns of bilingual lexical and conceptual processing are not reduced to a simple dichotomy. The effects of lexical and conceptual factors were examined in the modified replication of the revised hierarchical model (Sholl et al. 1995) study. Contrary to the predictions that follow from this model, there was no significant facilitation of responses to the stimuli

that were primed by pictures in the L1-to-L2 direction. Furthermore, in the opposite direction, the accuracy data of the stimuli that were primed by pictures and L1 words were characterized by negative transfer effect. Conversely, the accuracy data of the unprimed stimuli and the stimuli primed by L2 words did not show any transfer. Such effects cannot be accommodated by the revised hierarchical model. According to the model of conceptual structure mapping proposed here, relational networks of CS2 are less developed, and, as a result, may not activate a variety of interrelated senses following the presentation of an isolated L2 stimulus. In the L2-to-L1 direction, a lower proportion of correct translations was primed by pictures and L1 words. This was due to the fact that target CS1 representations primed by pictures and L1 words might not be associated with L2 translation stimuli. For example, the English translation stimulus nail may not be always associated with the Russian word *gvozd'* 'pointed piece of metal', nor with a picture that primes the same meaning in CS1. On the other hand, the unprimed stimuli or the stimuli that were primed by L2 words do not require the production of a specific target form. Therefore, any equivalent L1 form is acceptable.

This explanation demonstrates that lexical priming in the stimulus and the target language posit different processing demands. That is, a prime presented in the stimulus language does not constrain access to any specific contextual frame, whereas a lexical prime presented in the target language may posit more narrowly defined requirements regarding the type of a target representation. In this respect processing demands imposed by a picture prime and a lexical prime provided in the target language are parallel, and may be additive in a picture naming task. The latter assumption provides an explanation for the differential effect of picture naming in L1 (as the stimulus language) and in L2 (as

the target language) on translation times in the L1-to-L2 direction reported in the Sholl et al. (1995) study. Such an effect was not obtained in the opposite direction (from L2 to L1) because the relational networks of the stimulus language (L2) might not be developed enough to benefit from the activation of a particular target sense in the relational network of an L2 lexical item. Differences in production demands imposed by different types of priming stimuli may or may not require bilinguals to discriminate between sets of senses which can be activated by a stimulus lexical item. The translation of isolated word stimuli does not provide an adequate account of the processes engaged in the activation and retrieval of lexical information in both languages. Such translations do not channel activation in a particular direction, even when the word and picture primes are used to activate some target representations.

The analyses of the Sholl et al. (1995) study and its replications provides indirect evidence for the relational network organization endorsed by the present model. Predictions that follow from the structural and the developmental assumptions of this model are directly supported by the results obtained in the relation assessment experiment. The structural assumption of the model has been demonstrated to account for prototype effects observed in the relational organization of lexical items and for the instability of such effects in various linguistic contexts. The results demonstrate that the word pairs with semantically similar prototypical meanings were judged related considerably more often than the word pairs with related nonprototypical meanings, unless the latter were activated in the context of priming sentences. The interaction between network distance and priming demonstrates the significance of the instability in

the relational organization of the stimulus lexical items following activation of the target contextual frames.

The developmental assumption of the model maintains that bilingual lexical and conceptual access can be described in terms of the mapping metaphor. The incongruities in the relational organization of the two structures were reflected in the language-specific processing patterns of lexical stimuli presented in isolation. The results obtained in Experiment 4 showed distinct patterns in relatedness judgments obtained from the three language groups. The absence of a main effect of language indicates that the relational organization in the conceptual structures of the three languages is not entirely incompatible, particularly in the domains of perceptual salience that are generally associated with a stable prototype effect. The positive judgments provided for words with closely related prototypical meanings were characterized by comparable patterns across the three language groups. Distantly related pairs were less often recognized as related by both bilingual and monolingual speakers, because the prototypical meanings of the stimulus words belong to different functional frames. The judgments provided for the distantly related word pairs exhibit a greater discrepancy between the three groups, because the relational organization of the equivalent Russian and Spanish lexical-conceptual representations may not include contextual frames, which were intended to highlight the relations between prototypical and nonprototypical senses in English word pairs.

The guiding assumptions of the model were also supported by the results that demonstrated greater language-specific discrepancies when stimulus and inter-stimulus intervals were reduced from 2 seconds to 400 milliseconds. In this case participants had

to provide a decision much earlier, before they had a chance to explore the relational organization of the first stimulus word in a pair.

The experiments reported here were conducted to evaluate the proposed model of conceptual structure mapping. As in other areas of human cognition and perception, relational organization shows evidence of categorical graded structure. In its turn, this is associated with prototype effects in lexical and conceptual access. The results obtained in relation assessment tasks provide direct evidence of conceptual activation patterns in monolingual and bilingual speakers upon the presentation of English lexical items. The data produced by bilingual and monolingual speakers in the unprimed condition reflect activation patterns associated with language-specific conceptual organization in bilingual speakers. Conversely, the data obtained in the primed condition produced rather uniform patterns correlated with the activated knowledge domains. The combined experimental evidence supports the proposed model of bilingual memory organization. The model was shown to be sensitive to the factors causing instability in categorical graded structure. The proposed relational network organization constitutes a dynamic structure able to accommodate language-specific and language-independent patterns of bilingual production.

CHAPTER 8
IMPLICATIONS FOR RESEARCH IN BILINGUALISM

The proposed model of conceptual structure mapping has important implications for research in bilingual memory organization and language acquisition. Earlier hierarchical models employ different organizational representations (word association vs. concept mediation) and asymmetrical bi-directional connections between lexical and conceptual stores (the revised hierarchical model). These representations were intended to account for language-specific and language- independent patterns of bilingual performance. The present model introduces the notion of conceptual structure (CS) organized in an elaborated relational network. CS captures the intricate relation between lexical and conceptual representations. The structural and developmental assumptions of the model provide a means of accommodating both language-specific and language-independent bilingual data. While the notion of conceptual structure captures language-specific lexical-conceptual organization, the mapping metaphor offers a means of explaining how compatible conceptual representations interact in the conceptual structures of a bilinguals' two languages.

According to the present model, conceptual structure formation is closely associated with the processes inherent to language learning and general conceptual development. Simultaneous conceptual and language development in early bilinguals provides a higher activation threshold for the conceptual structure which is most closely

associated with the concept acquisition episode. Conversely, late bilinguals, whose conceptual development is primarily associated with L1 conceptual structure, demonstrate higher activation threshold for L1 relational organization even in the tasks that require only L2 access (relation assessment experiments in Chapter 5).

The findings reported in the second language acquisition literature suggest that the parallel acquisition of languages by children in different socio linguistic situations may lead to greater separation between L1 and L2 lexicons (Comeau, Genesee, Nicoladis, & Vrakas, 1996). Yet instances of code-switching in early bilinguals suggest that children can relate conceptual representations established through distinct linguistic systems (Genesee, Nicoladis & Paradis 1995). Genesee et al. (1995) suggest that code-switching in early bilinguals is conditioned by limited proficiency in one language or the other. The proposed model of conceptual structure mapping offers an additional explanation for code-switching, one which is not reflected in the literature. The model suggests that some lexical representations may not be immediately accessible, because accompanying contextual conditions do not match contexts of concept acquisition and primary usage. The validity of the present explanation is supported by the evidence of spontaneous translations, which sometimes occur with code-switching (Voltera & Taescher, 1978). Spontaneous translations point to the fact that children recognize their access problems and repair them.

A similar explanation accounts for adult code switching data. The phenomena of adult code-switching and language-mixing have been extensively reviewed in the bilingual literature as both socially and structurally conditioned (e.g. Lipski, 1977; Gumperz, 1982; DiSciullo, Muysken, Singh, 1986; Myers-Scotton, 1993). The existing

psycholinguistic approaches to the problem do not consider differences in L1 and L2 lexical-conceptual representations as a basis for the proposed accounts (Grosjean, 1995) and are limited to descriptions of pathological data (Green, 1986; Perecman, 1989; Hyltenstam, 1995).

Previous models of the bilingual lexicon do not sufficiently address the problem of transfer in bilingual production. The possibility of transfer (both positive and negative) between the representational systems of bilinguals' two languages has been suggested in the studies dealing with cognate priming patterns (de Groot & Nas, 1991; de Groot, 1992). The issues of transfer have been more closely examined within the framework of the Competition Model (McWhinney & Bates, 1987; Li, Bates & McWhinney, 1993). According to the Competition Model, transfer is viewed as a major source of the various syntactic processing strategies applied by bilinguals. However, the conditions that trigger transfer have not been clearly stated, possibly because of the lack of conceptual constructs on which they should operate. The present model of conceptual structure mapping offers a way to account for transfer in bilingual production. Transfer is best conceptualized as a straightforward mapping of bilinguals' conceptual structures. The compatible areas within conceptual structures are characterized by positive transfer. Such areas are associated with the domains of greater perceptual salience (e.g. concrete objects). Conversely, incompatible areas (such as extensions and metaphors) are characterized by negative transfer. The knowledge about incompatible extensions may not yet be available to a novice bilingual who is generally inclined to apply L1 extensions to L2 lexical items. On the other hand, a well-developed and highly accessible L2 conceptual structure can trigger transfer in the opposite direction, from L2 to L1.

The mapping metaphor also offers an explanation for the high activation threshold of both conceptual structures, even when the task is limited to one-language stimuli. Although the experimental stimuli and the instructions were all in English (experiments 3, 4 and 5 in Chapter 6), the highly fluent Russian-English and Spanish-English bilinguals tested have provided evidence of the influence of L1 lexical-conceptual organization on their judgments about relatedness of English words. This expands on previous findings reported by Ransdell and Fischler (1987) that bilinguals tend to access representations in other languages, even when experimental tasks do not require them to do so.

CHAPTER 9
CONCLUSION

A model of conceptual structure mapping was developed to account for unexplained phenomena in the performance of bilinguals. A series of experiments was performed to test the new model. The findings in these experiments validated the predictions of the model. They also accounted for the unexplained or even contradictory findings of previous studies and were compatible with the incontestable findings of other studies. Specifically, the structural and developmental assumptions of the new model provide a means of accounting for a variety of linguistic and ecological factors that contribute to the formation of a conceptual structure, the major theoretical construct of the model. The notion of conceptual structure provides a natural mechanism for the developmental shifts observed in bilingual production and constitutes a representational basis for activation patterns in lexical and conceptual access. The model has important implications for the role of language-specific structures in bilingual language processing and suggests a new direction for exploring various issues in the areas of language acquisition and processing.

APPENDIX

EXPERIMENTAL STIMULI AND CONDITIONS OF THEIR PRESENTATION

Table A-1. Distribution of experimental conditions in four sets of stimuli: Modified replication of the Sholl et al. (1995) experiment.

			Experimental tasks							
			Set 1		Set2		Set3		Set4	
	English	Russian	Study	Test	Study	Test	Study	Test	Study	Test
2	airplane	самолет	L1	E>R	L2	R>E	N	E>R	P	R>E
4	anchor	якорь	L2	R>E	N	E>R	P	E>R	L1	R>E
5	ant	муравей	P	R>E	L1	E>R	L2	E>R	N	R>E
6	apple	яблоко	L1	R>E	L2	R>E	N	E>R	P	R>E
7	arm	рука	L2	R>E	N	E>R	P	E>R	L1	R>E
8	arrow	стрела	L2	E>R	N	R>E	P	R>E	L1	E>R
10	ashtray	пепельнница	L1	E>R	L2	E>R	N	R>E	P	E>R
12	ax	топор	L2	R>E	N	E>R	P	E>R	L1	R>E
14	ball	мяч	L1	R>E	L2	R>E	N	E>R	P	R>E
15	balloon	шарнк	P	E>R	L1	R>E	L2	R>E	N	E>R
17	barn	амбар	N	E>R	P	R>E	L1	E>R	L2	E>R
18	barrel	бочка	L2	R>E	N	E>R	P	E>R	L1	R>E
20	basket	корзнна	P	E>R	L1	R>E	L2	R>E	N	E>R
22	bed	кровать	L1	E>R	L2	E>R	N	R>E	P	E>R
23	bee	пчела	L2	E>R	N	R>E	P	R>E	L1	E>R
24	beetle	жук	L1	E>R	L2	E>R	N	R>E	P	E>R
25	bell	колокольчнк	P	R>E	L1	E>R	L2	E>R	N	R>E
26	belt	ремень	P	R>E	L1	E>R	L2	E>R	N	R>E
27	bicycle	велоснпед	L1	R>E	L2	R>E	N	E>R	P	R>E
28	bird	птнца	N	R>E	P	E>R	L1	R>E	L2	R>E
30	book	кннга	L1	E>R	L2	E>R	N	R>E	P	E>R
31	boot	сапог	L2	R>E	N	E>R	P	E>R	L1	R>E
32	bottle	бутылка	L1	R>E	L2	R>E	N	E>R	P	R>E
33	bow	бант	L1	E>R	L2	E>R	N	R>E	P	E>R
34	bowl	мнска	N	R>E	P	E>R	L1	R>E	L2	R>E
35	box	коробка	L2	E>R	N	R>E	P	R>E	L1	E>R
36	bread	клеб	L1	R>E	L2	R>E	N	E>R	P	R>E
37	broom	метла	L1	E>R	L2	E>R	N	R>E	P	E>R

Table A-1 (Continued)

			Experimental tasks							
			Set 1		Set2		Set3		Set4	
S&V	English	Russian	Study	Test	Study	Test	Study	Test	Study	Test
38	brush	щетка	L2	E>R	N	R>E	P	R>E	L1	E>R
39	bus	автобус	L1	R>E	L2	R>E	N	E>R	P	R>E
40	butterfly	бабочка	N	E>R	P	R>E	L1	E>R	L2	E>R
41	button	пуговница	P	R>E	L1	E>R	L2	E>R	N	R>E
42	cake	торт	L1	E>R	L2	E>R	N	R>E	P	E>R
43	camel	верблюд	L1	R>E	L2	R>E	N	E>R	P	R>E
44	candle	свеча	N	R>E	P	E>R	L1	R>E	L2	R>E
46	cap	кепка	L1	R>E	L2	R>E	N	E>R	P	R>E
48	carrot	морковь	N	E>R	P	R>E	L1	E>R	L2	E>R
49	cat	кошка	L1	R>E	L2	R>E	N	E>R	P	R>E
50	caterpillar	гусеница	P	R>E	L1	E>R	L2	E>R	N	R>E
52	chain	цепь	N	R>E	P	E>R	L1	R>E	L2	R>E
53	chair	стул	L1	R>E	L2	R>E	N	E>R	P	R>E
54	cherry	вишня	L1	R>E	L2	R>E	N	E>R	P	R>E
55	chicken	курица	N	R>E	P	E>R	L1	R>E	L2	R>E
56	chisel	долото	L1	E>R	L2	E>R	N	R>E	P	E>R
57	church	церковь	N	E>R	P	R>E	L1	E>R	L2	E>R
60	clock	часы	L2	E>R	N	R>E	P	R>E	L1	E>R
62	cloud	облако	L2	E>R	N	R>E	P	R>E	L1	E>R
64	coat	пальто	L2	R>E	N	E>R	P	E>R	L1	R>E
65	comb	расческа	L2	E>R	N	R>E	P	R>E	L1	E>R
67	couch	диван	L1	R>E	L2	R>E	N	E>R	P	R>E
68	cow	корова	L2	E>R	N	R>E	P	R>E	L1	E>R
69	crown	корона	L2	R>E	N	E>R	P	E>R	L1	R>E
71	deer	олень	L2	R>E	N	E>R	P	E>R	L1	R>E
72	desk	письменный стол	P	E>R	L1	R>E	L2	R>E	N	E>R
73	dog	собака	L2	E>R	N	R>E	P	R>E	L1	E>R
74	doll	кукла	L2	R>E	N	E>R	P	E>R	L1	R>E
75	fence	забор	N	R>E	P	E>R	L1	R>E	L2	R>E
76	door	дверь	L2	E>R	N	R>E	P	R>E	L1	E>R
78	dress	платье	L2	E>R	N	R>E	P	R>E	L1	E>R
79	dresser	комод	N	E>R	P	R>E	L1	E>R	L2	E>R
80	drum	барабан	P	E>R	L1	R>E	L2	R>E	N	E>R
81	duck	утка	L2	R>E	N	E>R	P	E>R	L1	R>E
83	ear	ухо	N	E>R	P	R>E	L1	E>R	L2	E>R
84	elephant	слон	L2	E>R	N	R>E	P	R>E	L1	E>R
85	envelope	конверт	P	R>E	L1	E>R	L2	E>R	N	R>E

Table A-1 (Continued)

			Experimental tasks							
			Set 1		Set2		Set3		Set4	
S&V	English	Russian	Study	Test	Study	Test	Study	Test	Study	Test
86	eye	глаз	L2	E>R	N	R>E	P	R>E	L1	E>R
87	donkey	осел	N	E>R	P	R>E	L1	E>R	L2	E>R
88	toe	палец ноги	L2	E>R	N	R>E	P	R>E	L1	E>R
89	fish	рыба	P	R>E	L1	E>R	L2	E>R	N	R>E
91	flower	цветок	L2	E>R	N	R>E	P	R>E	L1	E>R
92	flute	флейта	L2	R>E	N	E>R	P	E>R	L1	R>E
93	fly	муха	L1	E>R	L2	E>R	N	R>E	P	E>R
94	foot	нога	L1	R>E	L2	R>E	N	E>R	P	R>E
97	fork	вилка	L2	E>R	N	R>E	P	R>E	L1	E>R
100	frog	лягушка	P	E>R	L1	R>E	L2	R>E	N	E>R
104	glass	стакан	P	E>R	L1	R>E	L2	R>E	N	E>R
106	glove	перчатка	N	R>E	P	E>R	L1	R>E	L2	R>E
109	grapes	виноград	N	E>R	P	R>E	L1	E>R	L2	E>R
110	grasshopper	кузнечик	P	E>R	L1	R>E	L2	R>E	N	E>R
114	hammer	молоток	N	R>E	P	E>R	L1	R>E	L2	R>E
116	hanger	вешалка	P	R>E	L1	E>R	L2	E>R	N	R>E
117	harp	арфа	L1	E>R	L2	E>R	N	R>E	P	E>R
121	horse	лошадь	N	E>R	P	R>E	L1	E>R	L2	E>R
123	iron	утюг	L1	E>R	L2	E>R	N	R>E	P	E>R
127	kettle	чайник	N	R>E	P	E>R	L1	R>E	L2	R>E
131	ladder	лестница	P	R>E	L1	E>R	L2	E>R	N	R>E
133	leaf	лист	N	R>E	P	E>R	L1	R>E	L2	R>E
137	lettuce	салат	L2	R>E	N	E>R	P	E>R	L1	R>E
139	light switch	выключатель	P	R>E	L1	E>R	L2	E>R	N	R>E
143	lock	замок	N	E>R	P	R>E	L1	E>R	L2	E>R
144	mitten	варежка	P	R>E	L1	E>R	L2	E>R	N	R>E
145	monkey	обезьяна	N	E>R	P	R>E	L1	E>R	L2	E>R
146	moon	месяц	L2	R>E	N	E>R	P	E>R	L1	R>E
151	nail	гвоздь	P	E>R	L1	R>E	L2	R>E	N	E>R
153	necklace	бусы	N	R>E	P	E>R	L1	R>E	L2	R>E
156	nut	гайка	P	E>R	L1	R>E	L2	R>E	N	E>R
159	ostrich	страус	N	R>E	P	E>R	L1	R>E	L2	R>E
160	owl	филин	P	R>E	L1	E>R	L2	E>R	N	R>E
161	paintbrush	кисть	P	R>E	L1	E>R	L2	E>R	N	R>E
162	pants	брюки	N	E>R	P	R>E	L1	E>R	L2	E>R
163	peach	персик	N	R>E	P	E>R	L1	R>E	L2	R>E
164	peacock	павлин	L2	R>E	N	E>R	P	E>R	L1	R>E

Table A-1 (Continued)

			Experimental tasks							
			Set 1		Set2		Set3		Set4	
S&V	English	Russian	Study	Test	Study	Test	Study	Test	Study	Test
165	peanut	арахис	P	R>E	L1	E>R	L2	E>R	N	R>E
166	pear	груша	P	E>R	L1	R>E	L2	R>E	N	E>R
172	pig	свиньа	L1	R>E	L2	R>E	N	E>R	P	R>E
173	pineapple	ананас	L1	E>R	L2	E>R	N	R>E	P	E>R
174	pipe	трубка	P	E>R	L1	R>E	L2	R>E	N	E>R
175	pitcher	кувшин	P	E>R	L1	R>E	L2	R>E	N	E>R
176	pliers	плоскогубцы	P	R>E	L1	E>R	L2	E>R	N	R>E
177	plug	внлка	N	E>R	P	R>E	L1	E>R	L2	E>R
179	pot	кастрюля	L2	E>R	N	R>E	P	R>E	L1	E>R
180	potato	картошка	N	E>R	P	R>E	L1	E>R	L2	E>R
181	pumpkin	тыква	L1	E>R	L2	E>R	N	R>E	P	E>R
183	raccoon	енот	N	E>R	P	R>E	L1	E>R	L2	E>R
187	ring	кольцо	L1	R>E	L2	R>E	N	E>R	P	R>E
192	ruler	лннейка	N	R>E	P	E>R	L1	R>E	L2	R>E
193	sailboat	парусник	L1	R>E	L2	E>R	N	R>E	P	E>R
194	saltshaker	солонка	L1	R>E	L2	R>E	N	E>R	P	R>E
195	sandwich	бутерброд	L2	E>R	N	R>E	P	R>E	L1	E>R
196	saw	пнла	P	E>R	L1	R>E	L2	R>E	N	E>R
197	scissors	ножнницы	N	R>E	P	E>R	L1	R>E	L2	R>E
198	screw	внит	L2	R>E	N	E>R	P	E>R	L1	R>E
199	screwdriver	отвертка	P	E>R	L1	R>E	L2	R>E	N	E>R
201	seal	тюлень	L1	E>R	L2	E>R	N	R>E	P	E>R
202	sheep	овца	L2	R>E	N	E>R	P	E>R	L1	R>E
203	shirt	рубашка	N	R>E	P	E>R	L1	R>E	L2	R>E
204	shoe	ботнок	L1	R>E	L2	R>E	N	E>R	P	R>E
205	skirt	юбка	L2	R>E	N	E>R	P	E>R	L1	R>E
206	skunk	скунс	L1	E>R	L2	E>R	N	R>E	P	E>R
207	sled	санки	N	R>E	P	E>R	L1	R>E	L2	R>E
208	snail	улнтка	L2	E>R	N	R>E	P	R>E	L1	E>R
209	snake	змея	L2	R>E	N	E>R	P	E>R	L1	R>E
210	snowman	снеговнк	L1	E>R	L2	E>R	N	R>E	P	E>R
212	spider	паук	L1	R>E	L2	R>E	N	E>R	P	R>E
214	spool	катушка	P	R>E	L1	E>R	L2	E>R	N	R>E
215	spoon	ложка	N	E>R	P	R>E	L1	E>R	L2	E>R
216	squirrel	белка	P	R>E	L1	E>R	L2	E>R	N	R>E
217	star	звезда	L1	E>R	L2	E>R	N	R>E	P	E>R
218	stool	табурет	L1	E>R	L2	E>R	N	R>E	P	E>R
219	stove	плнта	P	R>E	L1	E>R	L2	E>R	N	R>E

Table A-1 (Continued)

			Experimental tasks							
			Set 1		Set2		Set3		Set4	
S&V	English	Russian	Study	Test	Study	Test	Study	Test	Study	Test
220	strawberry	клубиика	P	E>R	L1	R>E	L2	R>E	N	E>R
221	suitcase	чемодан	L2	R>E	N	E>R	P	E>R	L1	R>E
222	sun	солице	L1	R>E	L2	R>E	N	E>R	P	R>E
223	swan	лебедь	N	E>R	P	R>E	L1	E>R	L2	E>R
225	swing	качели	P	E>R	L1	R>E	L2	R>E	N	E>R
226	table	стол	L1	E>R	L2	E>R	N	R>E	P	E>R
230	thimble	иаперсток	P	E>R	L1	R>E	L2	R>E	N	E>R
231	thumb	палец	N	E>R	P	R>E	L1	E>R	L2	E>R
232	tie	галстук	N	R>E	P	E>R	L1	R>E	L2	R>E
235	finger	палец	L2	R>E	N	E>R	P	E>R	L1	R>E
236	tomato	помидор	N	E>R	P	R>E	L1	E>R	L2	E>R
238	top	волчок	L2	E>R	N	R>E	P	R>E	L1	E>R
240	train	поезд	P	E>R	L1	R>E	L2	R>E	N	E>R
244	turtle	черепаха	P	R>E	L1	E>R	L2	E>R	N	R>E
247	vest	жилет	N	R>E	P	E>R	L1	R>E	L2	R>E
249	wagon	тележка	P	E>R	L1	R>E	L2	R>E	N	E>R
250	watch	часы	P	E>R	L1	R>E	L2	R>E	N	E>R
252	watermelon	арбуз	N	R>E	P	E>R	L1	R>E	L2	R>E
254	wheel	колесо	N	E>R	P	R>E	L1	E>R	L2	E>R
255	whistle	свисток	P	R>E	L1	E>R	L2	E>R	N	R>E

Note: P = picture prime; L1 = first language (Russian) word prime; L2 = second language (English) word prime; N = new (unprimed) word stimuli; R>E = translation from Russian from English; E>R = translation from English to Russian; S&V = a number under which words appear in the Snodgrass and Vanderwart (1980) standardized set of picture and word norms.

Table A-2. A list of filler stimuli used in picture sorting and lexical decision tasks.

	Picture primes		Word primes	
S&V	English	Russian	English nonwords	Russian nonwords
21	bear	медведь	toxfter	сфбель
45	cannon	пушка	hsea	пялмшкац
66	corn	кукуруза	destb	цацец
70	cup	чашка	fensde	вклтосы
99	french horn	валториа	piattno	виетитор
101	frying pan	сковорода	broar	шурч
120	helicopter	вертолет	gitr	тигм
149	mouse	мышь	fdorgt	аллиφор
170	pepper	перец	krite	пигывель
245	umbrella	зоит	ightl	здреба

Note: S&V = a number under which words appear in the Snodgrass and Vanderwart (1980) standardized set of picture and word norms.

Table A-3. Unprimed translations produced for primed stimuli: Modified replication of the Sholl et al. (1995) study.

Prime	Translation from L1 to L2	
Picture	L1 stimulus	L2 response
ladder	*lestnica* (ladder, staircase)	staircase
monkey	*obeziana* (monkey, ape)	ape
clock	*chasy* (clock, watch)	watch
lock	*zamok* (lock, castle)	castle
L2 word	L1 stimulus	L2 response
arm	*ruka* (arm, hand)	hand
deer	*olen'* (deer, elk)	elk
lettuce	*salat* (lettuce, salad)	salad
foot	*noga* (foot, leg)	leg
leaf	*list* (leaf, sheet)	sheet
balloon	*shar* (balloon, ball)	ball
wagon	*telezhka* (cart, wagon)	cart
kettle	*chajnik* (kettle, teapot)	teapot

Table A-3. (Continued)

Prime	Translation from L2 to L1	
Picture	L2 stimulus	L1 response
nut (fastener)	nut	*orex* (nut = kernel)
nail (pointed peice of metal)	nail	*nogod'* (fingernail)
saw (a tool)	saw	*videl* (past tense of "to see")
ruler (a tool)	ruler	*vlastelin* (sovereign)
L1 word	L2 stimulus	L1 response
tulen' (seal = animal)	seal	*pechat'* (stamp, sticker)
ut'ug (an iron)	iron	*zhelezo* (iron - substance)
kolokol'chik (a bell)	bell	*zvonit'* (to chime, to toll)

Note: L1 = first language (Russian); L2 = second language (English).

Table A-4. Distribution of experimental conditions in four sets of stimuli: Replication of the Sholl et al. (1995) experiment.

			Translation tasks			
			From L2 to L1		From L1 to L2	
	English (L2)	Russian (L1)	Set 1	Set 2	Set 3	Set 4
1	cannon	пушка	L1	New	New	L2
2	frog	лягушка	L2	New	L1	New
3	pear	груша	New	L1	L2	New
4	stove	плита	New	L2	New	L1
5	whistle	свисток	L1	New	New	L2
6	seal	тюлень	L2	New	L1	New
7	mitten	варежка	New	L1	L2	New
8	duck	утка	New	L2	New	L1
9	belt	ремень	L1	New	New	L2
10	airplane	самолет	L2	New	L1	New
11	candle	свеча	New	L1	L2	New
12	foot	нога	New	L2	New	L1
13	peanut	арахис	L1	New	New	L2
14	stool	табурет	L2	New	L1	New
15	wheel	колесо	New	L1	L2	New
16	screwdriver	отвертка	New	L2	New	L1
17	lock	замок	L1	New	New	L2
18	drum	барабан	L2	New	L1	New
19	bell	колокольчик	New	L1	L2	New
20	anchor	якорь	New	L2	New	L1
21	cap	кепка	L1	New	New	L2
22	glass	стакан	L2	New	L1	New
23	pineapple	ананас	New	L1	L2	New

Table A-4 (Continued)

			Translation tasks			
			From L2 to L1		From L1 to L2	
	English (L2)	Russian (L1)	Set 1	Set 2	Set 3	Set 4
24	strawberry	клубника	New	L2	New	L1
25	watch	часы	L1	New	New	L2
26	scissors	ножницы	L2	New	L1	New
27	leaf	лист	New	L1	L2	New
28	dresser	комод	New	L2	New	L1
29	cake	торт	New	New	New	L2
30	bed	кровать	L1	New	New	New
31	ant	муравей	L2	New	L1	New
32	carrot	морковь	New	L1	L2	New
33	hammer	молоток	New	L2	New	L1
34	pipe	трубка	L1	New	New	L2
35	suitcase	чемодан	L2	New	L1	New
36	turtle	черепаха	New	L1	L2	New
37	saw	пила	New	L2	New	L1
38	ladder	лестница	L1	New	New	L2
39	donkey	ослик	L2	New	L1	New
40	bear	медведь	New	L1	L2	New
41	arm	рука	New	L2	New	L1
42	caterpillar	гусеница	L1	New	New	L2
43	hanger	вешалка	L2	New	L1	New
44	plug	штепсель	New	L1	L2	New
45	swing	качели	New	L2	New	L1
46	train	поезд	L1	New	New	L2
47	ring	кольцо	L2	New	L1	New
48	kettle	чайник	New	L1	L2	New
49	desk	письменный стол	New	L2	New	L1
50	basket	корзина	L1	New	New	L2
51	bird	птица	L2	New	L1	New
52	ear	ухо	New	L1	L2	New
53	moon	месяц	New	L2	New	L1
54	shoe	ботинок	L1	New	New	L2
55	thumb	палец	L2	New	L1	New
56	pot	кастрюля	New	L1	L2	New
57	helicopter	вертолет	New	L2	New	L1
58	church	церковь	L1	New	New	L2
59	balloon	шарик	L2	New	L1	New
60	couch	диван	New	L1	L2	New

Table A-4 (Continued)

			Translation tasks			
			From L2 to L1		From L1 to L2	
	English (L2)	Russian (L1)	Set 1	Set 2	Set 3	Set 4
61	iron	утюг	New	L2	New	L1
62	pumpkin	тыква	L1	New	New	L2
63	tie	галстук	L2	New	L1	New
64	squirrel	белка	New	L1	L2	New
65	paintbrush	кисть	New	L2	New	L1
66	fly	муха	L1	New	New	L2
67	button	пуговица	L2	New	L1	New
68	barrel	бочка	New	L1	L2	New
69	elephant	слон	New	L2	New	L1
70	nail	гвоздь	L1	New	New	L2
71	snake	змея	L2	New	L1	New
72	nut	гайка	New	L1	L2	New
73	fish	рыба	New	L2	New	L1
74	broom	метла	L1	New	New	L2
75	envelope	конверт	L2	New	L1	New
76	necklace	бусы	New	L1	L2	New
77	snowman	снеговик	New	L2	New	L1
78	bread	хлеб	L1	New	New	L2
79	spider	паук	L2	New	L1	New
80	book	книга	New	L1	L2	New

Note: L1 = previously named in Russian; L2 = previously named in English; New = presented as new (unprimed) stimuli.

Table A-5. Filler stimuli used in a picture naming task: Replication of the Sholl et al. (1995) experiment.

	Pictures named in English		Pictures named in Russian	
	English	Russian	English	Russian
1	dress	платье	star	звезда
2	horse	лошадь	ruler	линейка
3	spoon	ложка	cherry	вишня
4	bus	автобус	dog	собака
5	umbrella	зонт	mushroom	гриб
6	shirt	рубашка	chain	цепочка
7	cup	чашка	bicycle	велосипед
8	crown	корона	pig	свинья
9	fence	забор	ax	топор
10	apple	яблоко	wagon	тележка

Table A-6. Unprimed translations produced for previously named concepts: Replication of the Sholl et al. (1995) study.

Picture	Picture Name	Translation Stimulus	Translation Response
	In L2	In L1	In L2
balloon	balloon	*sharik* (balloon, ball)	ball
moon	moon	*mes'ac* (moon, month)	month
arm	arm	*ruka* (arm, hand)	hand
paintbrush	paintbrush	*kist'* (paintbrush, hand)	hand
foot	foot	*noga* (foot, leg)	leg
leaf	leaf	*list* (leaf, sheet)	sheet
ladder	ladder	*lestnica* (ladder, staircase)	staircase
lock	lock	*zamok* (lock, castle)	castle
	In L1	In L2	In L1
stool	*taburet* (a stool)	stool	*stul* (a chair)
ring	*kol'co* (a ring)	ring	*zvonit'* (to ring)
saw	*pila* (a saw)	saw	*videl* (past tense of "to see")
iron	*ut'ug* (an iron)	iron	*zhelezo* (iron - substance)
wheel	*koleco* (a wheel)	wheel	*rul'* (a wheel of a car)
plug	*shtepsel'* (a plug)	plug	*zatychka* (a stopper)
nail	*gvozd'* (a nail)	nail	*nogod'* (a fingernail)

Note: L1 = first language (Russian); L2 = second language (English).

Table A-7. A list of word pairs and priming sentences used in relation assessment experiments.

Word pairs	Priming sentences
Stimulus set 1:	
pen - stall	In a hay-strewn pen, the lambs frolic. Once the sheep are older and less prone to illness, farmers would like to take them to schools, showing city kids about the animal world beyond household pets.
stamp - mark	To make up for huge losses, the Russian leader recently decreed that every bottle of vodka had to bear a special stamp to prove it had been produced legally.
switch - trash	Are there times you use certain words with your friends, then switch to another way of speaking when you are with another group of people?
clip - film	Ever notice how awful a video clip looks on a computer when you blow it up to fill the screen?

Table A-7. (Continued)

Word pairs	Priming sentences
Stimulus set 1:	
moon - basket	A full moon lighted the terrain like candlelight
firm - obstinate	The UN secretary-general's letter confirmed his intense interest, concern and his firm decision to contribute to a Cyprus solution.
fortune - wealth	In some of the poorer neighborhoods, shopkeepers made small fortunes by charging double the phone company's rates for local calls made from their shops.
date - rendezvous	Victim advocates say teenagers are at a greater risk than adults for date violence because they are inexperienced at dating and may assume that their relationship, even if abusive, is the way dating is supposed to be.
master - expert	The first rule of successful art forgery, according to one of the world's greatest exponents of the craft, is never to copy the old masters.
brush - touch	I suppose we became too accustomed to players' flopping backward at the slightest brush, as though they had just been struck by an Amtrak locomotive.
block - neighborhood	When garbage piled up on the block because city trucks hadn't come around for 10 days, the residents hauled the trash to the dump themselves.
ruin - debris	A team led by a professor of geology at Hokkaido University, will excavate ruins dating from before the Jomon period.
break - pause	In dual-income families, partners' jobs buffer each other against layoffs, carrier changes and breaks.
spring - emerge	Although the ban is still on, gambling operations are springing up all over China - in some cases, with the help of government officials themselves.
salt - doubt	Realtors warn new-home buyers to follow 'home affordability' charts with a grain of salt. For the most part, the charts list monthly payments but only include principal and interest.

Table A-7. (Continued)

Word pairs	Priming sentences
Stimulus set 1:	
cat - tire	Police found 13 mistreated cats and several animal carcasses in the home of a man who once ran a local animal rights group and has repeatedly run for elected office.
agent - police	Valencia's arrest was the result of one year's work by the Federal Police with the help of FBI agents.
fan - ventilate	On tiny private islands owned by cruise lines, azure waters lap the white sands and a warm tropical breeze fans the palm trees.
plug - promotion	Although regulations limit product plugs on TV shows, exceptions have started to creep in, most prominently on NBC's 'Seinfeld', whose characters are constantly prattling about Snapple, Cadillacs and other brands.
drug - medicine	The Health and Welfare Ministry issued a warning Thursday against a common hay fever drug, saying it had caused 17 cases of severe side effects since it was approved for use in 1990.
kid - tot	Kids USA Expo also will offer a tiny tots play area, mobile gym bus, craft projects that can be taken home, bowling, miniature golfing.
luck - chance	Our TV group was at that location quite by chance in search of a news report.
magazine - journal	Spending a fortune is back in style and the rich are reading all about it in magazines just for them.
preservative - condom	All canned food is thoroughly cooked, and as a consequence, preservatives are used in relatively few canned foods, far less than for many so-called fresh foods.
ring - arena	A no-holds-barred fight is shaking up the world of championship wrestling, but the rumble isn't in the ring, it is between media moguls who air wrestling matches.
train - teach	When retired U.S. boxer Eddie Townsend was invited to train young, aspiring boxers in Japan in 1962, he considered it merely a one-year stint.

Table A-7. (Continued)

Word pairs	Priming sentences
Stimulus set 1:	
grave - serious	The relief, however, is far too small to ease help solve the grave food shortage in the North Korea.
ceiling - limit	The administration plans new ceilings on the value of preferential contracts for minorities depending of how much bias is thought to have existed in an industry or regions.
rest - subtract	About half of our sales are in North America and the rest are in Europe, Asia-Pacific and Latin America.
ward - fend	Research is growing into the possibility of developing vaccines for cancers. The vaccines, despite their name, wouldn't be used by healthy people to ward off cancer.
motivation - drive	The Republicans on the eve of the first Southern primary were united on one thing: their drive to win favor with religious conservatives, a particularly potent voting bloc in South Carolina.
cook - saw	Fresh fettuccine cooks in 3 minutes, as against 10 to 12 minutes for the dried variety.
jam - crush	County commissioners declared a disaster as ice jams pushed the Yellowstone River two feet above flood stage.
court - assembly	The former servants, sewing maids or descendants of the king's inner circle appeared to recall the way the shy queen's face grew red when she was forced to consort with the crowd at court.
party - globe	More than a million revelers were expected to jam the French Quarter of New Orleans during Mardi Gras, America's biggest street party.
shield - conceal	In the case involving Richard Nixon and Watergate, the high court said the president can't use executive privilege to shield evidence of a crime.
horn - trumpet	I was amazed at the number of people who tooted their horn and waved at me.

Table A-7. (Continued)

Word pairs	Priming sentences
Stimulus set 1:	
armor - cover	Olof Palme, the late prime minister of Sweden, was shot 10 years ago in the back at point blank range with a gun containing armor-piercing bullets.
gay - blue	The prejudice toward old people is much like the bigotry that is hurled against other oppressed groups, including gays.
sign - gesture	The sign language classes have another benefit. That makes the school a more hospitable place for deaf students who join hearing classrooms.
prevent - anticipate	To prevent other acts of civil disobedience, the government has banned all public gatherings.
way - manner	The project must be completed in a way that is satisfactory to the public.
dictate - recite	I did write the story, though. It was just easier to dictate it to someone else.
opening - opportunity	The special education system misses federally mandated deadlines so often that an estimated 1,000 children await evaluation and placement, a backlog that creates an opening for parents to sue.
shave - eat	The company plans to shave another 4 billion yen in costs but will be unable to make up for the drop in sales.
comfort - consolation	MILAN gained little comfort from the news that the government planned a mini-budget to ease Italy's path to EMU membership.
juice - sock	In one of the best known cases in the 1980s, Beech Nut was discovered to be selling apple juice adulterated with sugar and water, and one of it's top executives was sent to jail.
dig - excavate	You cannot dig up your infrastructure and take it away if the government decides to nationalize it.
fence - barrier	Like their candidate, Buchanan supporters rail against illegal immigration and endorse building a fence alone the Mexican border.

Table A-7. (Continued)

Word pairs	Priming sentences
Stimulus set 1:	
star - actor	EASY RIDER was the quintessential hippie movie, in which the stars have acknowledged that there was plenty of marijuana and LSD use off-screen as well as on.
crack - good	With their unstable fields of harmony and schizophrenic shifts of mood, the Nielsen symphonies are tough nuts for conductors to crack.
greet - wave	The great thing about farm is that everybody knows everybody, everybody waves.
chunk - part	Paczki restaurant, a 18-year-old Italian-Polish eatery, is the kind of place where a good chunk of the customers are regulars.
tile - beach	The restaurant has a moody, hacienda-style look with wall tapestries, tile flooring, wrought-iron detail, dark furniture and Portuguese tile ovens.
coach - mentor	Before joining the Met in 1941, Conner frequently sang on national radio. She and her husband moved to Cypress in 1970, and in retirement she was a mentor for young singers.
legend - myth	In Miao legend, silver comes from the scraps left from the making of the moon and the pillars that hold up the sky.
bargain - negotiate	Last month, President Clinton gave approval for Cargill to negotiate the sale to help North Korea cope with a food crisis.
coup - upset	Pretoria's flirting with the idea of selling battlefield tank parts to Syria can upset the fragile Middle East peace process.
leap - float	Astronauts Harbaugh and Tanner planned to float out of the shuttle's cargo bay airlock shortly before midnight to install a new data recorder.
boat - ship	Boat makers and sellers are pinning their fortunes this year on the lure of radical new hull designs and super-fast engines,

Table A-7. (Continued)

Word pairs	Priming sentences
Stimulus set 2:	
solid - compact	If the drain isn't clear after about 10 minutes, the clog is probably more solid.
exit - book	One time they pulled all the books out of the shop window and burned them in the middle of the square.
wind - turn	The 142-km high-tech corridor winds its way through development zones with a total planned construction area of 80 sq.km.
sharp - clever	His mind is as sharp as his fists used to be.
glass - stripe	A glass wall around an outdoor coffee bar was shattered, showering glass onto people nearby.
rain - shower	Only a chance of showers was predicted for last night.
stream - creek	Human development and urbanization was always near a stream or a river or an estuary.
valet - lamp	Mozart complained of being seated at the dining table with the valets and cooks, like a common servant.
doze - nap	A 8-month-old yellow Labrador retriever enthusiastically greets guests as they arrive, gets a couple of pats on the head and dozes off again in a corner.
intimate - close	Estevez, a close friend of Cruise, happened to be in Europe while Mission Impossible was being filmed there.
gloomy - grim	Gloomy notices will be arriving in hundreds of thousands of mailboxes in the next few weeks: The government is cutting off disability benefits for up to half a million elderly and disabled legal immigrants.
rare - raw	Place the steaks on the log, and cook, turning once, for 3 to 6 minutes a side for rare, and for 6 to 9 minutes for medium-rare depending on the log and the fire.

Table A-7. (Continued)

Word pairs	Priming sentences
Stimulus set 2:	
alarm - fashion	On several occasions, a source said, patrol headquarters tried to dispatch the officer to a building where a burglar alarm had gone off.
tower - dominate	Delphi is twice as big as its nearest rival, Japan's Denso group, and towers over other competitors.
swell - expand	China's labour force will swell over the next 30 years to become the biggest the country has ever seen.
bulb - knife	A standard 60-watt incandescent bulb lasts for about 750 hours.
butter - wire	Instead of trying to butter up potential customers, the car salesmen at Mercedes are almost trying to deter customers at least until the waiting list starts to dwindle.
iron - press	Van de Broek suggest to continue mutual discussion to iron out remaining differences.
soap - detergent	Food preparers in households where E. coli infection was confirmed were more likely to say they did not wash their hands with soap and water after handling raw ground beef.
bolt - cup	Someone tampered with my car. They took the bolts and screws out of the ball joints to make a front wheel come off.
belt - zone	In the 1980s, three hard freezes wiped out thousands of acres in what once was our state's citrus belt.
mouse - frame	The square wooden frames around the arching stained-glass windows showed where the church's original windows had been.
shoulder - edge	The safest way to handle being stranded on the road shoulder is to remain calm.
loan - wet	Until now the creditors doubted that, given the low petrol prices, the loans will be repaid
table - counter	Roosters, hens and itty-bitty chicks have the run of the yard, eating crumbs under the tables and sometimes running over diners' feet.

Table A-7. (Continued)

Word pairs	Priming sentences
Stimulus set 2:	
affair - business	The president assured that he would run the affairs of state in an efficient and transparent manner and would establish good working relations with the opposition.
dish - platter	Her oil pastel painting of a dog with blue fur in a room with flowers and a food dish will be displayed.
foot - base	One man lies crumpled at the foot of a pillar, with a dagger protruding from his chest.
wedge - bind	And there is no attempt to drive a wedge between employees.
violin - whistle	While listening to a symphonic orchestra, you may hear a lot of violins, then the cellos come in, then perhaps the flutes.
bug - defect	Although companies like Microsoft Corp. say their programmers spend up to half their time working the bugs out of new software, much of the troubleshooting takes place when the product is largely developed.
pig - sail	Hong Kong surgeon Dr. Jonathan Ho Kei-shing, accused of manslaughter over a pig-to-man heart transplant, was granted bail after 40 days in an Indian prison.
stool - toast	Elegant stools surround the tiled bar that wraps three sides of the open kitchen.
chain - duck	The Florida grocery chain Publix Super Markets Inc. agreed to pay $ 81.5 million to settle a class-action sex discrimination case.
bottle - helmet	When visiting friends, she usually shows up with a bottle of wine in her backpack.
clown - jester	He went from being a clown to a nationally recognized figure.
fork - cow	Pour the broth around the meatloaf and stir with a fork to combine with the ketchup.
drum - knife	Government officials banned the church choir and the use of drums during religious services two years ago.

Table A-7. (Continued)

Word pairs	Priming sentences
Stimulus set 1:	
key - clue	Those who have passed the test say there is no key to success.
rat - mushroom	The city is tearing down the worst buildings, but progress is slow and thousands still live amid the rats and trash.
skirt - detour	Satellite dish technology will easily skirt the border checkpoints erected by cultural protectionists.
tomato - spider	The burritos are huge and loaded with lettuce, tomato and onion.
watch - guard	Despite UN assistance to rebuild the houses, and US troops from a NATO base half a kilometer away to watch over the Serb police, only 14 of the thousand plus former Moslem occupants have come back.
canyon - war	The park service was criticized two weeks ago when its hunters killed dozens of sheep grazing in canyons.
skate - roll	If she skates as flawlessly at the world championships next month in Lausanne, Switzerland.
bus - candle	Citizens take the risk of being gunned down every time they perform a simple task like riding a bus, fixing a flat tire, even sitting in their living rooms.
bird - rattle	It was the third time birds have been found dead near the school since around Jan. 20, the principal said.
fright - fear	The series of creepy children's thrillers that has enjoyed phenomenal popularity in recent years, produced a sudden fright for its publisher yesterday after investors learned of the books' declining sales
drain - empty	Begin by shutting off the sink's water supply. Turn on the faucet to drain any water in the fixture's pipes.
slight - omit	He feels slights keenly, like his omission from the last Dream Team, which he deserved to make but didn't.

Table A-7. (Continued)

Word pairs	Priming sentences
Stimulus set 2:	
sense - reason	Unfortunately, laws are amended so often that not only ordinary citizens but even officials directly responsible for the implementation of these laws cannot make sense of all the numerous amendments...
skim - browse	An autobiography by Dave Davies is loaded with sloppy writing, it's a book to skim rather than read.
grill - bike	Someone stole a gas grill from a condominium porch.
bear - support	Building an ever larger welfare state loaded the German economy with burdens which even that mighty engine can no longer bear.
anchor - jar	Lower rents are typical for anchor tenants of retail centers.
wage - tie	Wage increases will offset 75 per cent of the planned price rises.
thumb - wine	Cinemania 97 gets the thumbs up for multimedia wizardry and in-depth information.
bed - foundation	A group of children in white robes follows a procession of men carrying a statue of Mary surrounded by a bed of plastic roses.
mix - socialize	Clubs constantly struggle with the delicate balance of class and culture, and a good mix of single and married people.
fix - compose	A repair expert is often able to diagnose and fix a customer's telephone problem while the customer is on the telephone.

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BIOGRAPHICAL SKETCH

Dina Belyayeva was born in Moscow, Russia in 1967. In 1990, she received University Diploma cum laude from Moscow Pedagogical University, where she majored in English linguistics and education. Upon graduation she worked as a language instructor for the UNIDO Training Centre in Moscow, Russia. In 1993, she came to the University of Florida to pursue her doctorate in linguistics. She lives in Connecticut with her husband and a six-year-old son.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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August, 1997

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translations from L1 to L2 and from L2 to L1 were used to test the hypothesis. Categorized and randomized word lists in L1 and L2 were used as stimuli. Categorized lists were expected to draw attention to conceptual properties of the stimulus material, and consequently, create interference in the tasks that require conceptual activation (picture naming and translation from L1 to L2). On the other hand lexical-level processing was predicted to have no effect on the tasks that do not require access to the conceptual level of representation (word naming and translation from L2 to L1). L1-to-L2 and L2-to-L1 translations of randomized and categorized lists were compared to word and picture naming in L1 and L2. The findings supported the prediction that the two directions of translation engage different interlanguage connections. Category interference in bilingual translation was reported only when translation was performed in the direction from L1 to L2. The results obtained from the incidental recall task also agreed with the principle of transfer-appropriate processing. That is, the direction of translation that was hypothesized to require concept mediation (L1>L2) had a category interference effect in production but a category advantage in recall. The direction of translation that was hypothesized to be lexically mediated (L2 >L1) was insensitive to the effects of semantic context in production and also in recall.

The directional asymmetry was also demonstrated in semantic priming experiments. Priming effects reported were significantly greater when primes were presented in L1 and targets were presented in L2 than when primes were presented in L2 and targets were presented in L1 (Neely, Keefe, & Ross 1989, Altarriba 1992, Kroll & Sholl 1992). It was suggested that similar to L1-to-L2 translation L1 priming of L2